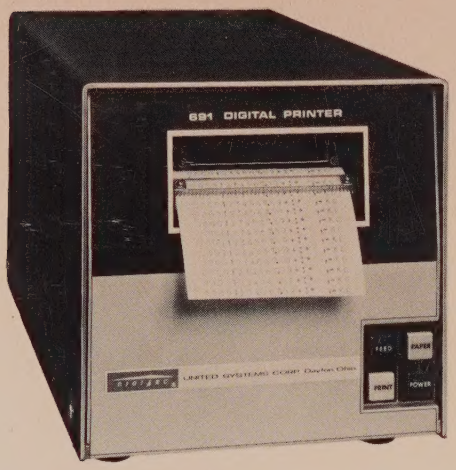
MP MASTER
MA33494

model 691 digital printer



instruction manual
mi-1249D

DIGIAC instrumentation

UNPACKING AND SHIPPING

After unpacking, carefully examine the instrument for physical damage that may have occurred in transit. If any damage is noted, immediately contact United Systems Corporation for further instructions.

If it should become necessary to return the instrument to United Systems Corporation, return in original packing or make certain that at least four inches of padding material surrounds the instrument to prevent damage during shipment. When returning instruments to the factory, give a full description of the failure of the instrument and the mode of operation that was used when the instrument failure occurred. Ship via REA Express, motor truck, or air freight PREPAID to:

United Systems Corporation
918 Woodley Road
Dayton, Ohio 45403

For foreign countries: Please contact your local representative for instructions.

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SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

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1. GENERAL INFORMATION

1.1 Features

The DigiTec Model 691 is a 21 column parallel entry drum printer specifically designed for the recording of BCD data output from digital instrumentation. The versatility of the printer enables it to interface with all DigiTec and most other measurement equipment on the market.

1.2 Technical Assistance

Additional interfacing assistance is available upon request. Contact the Technical Sales Department at:

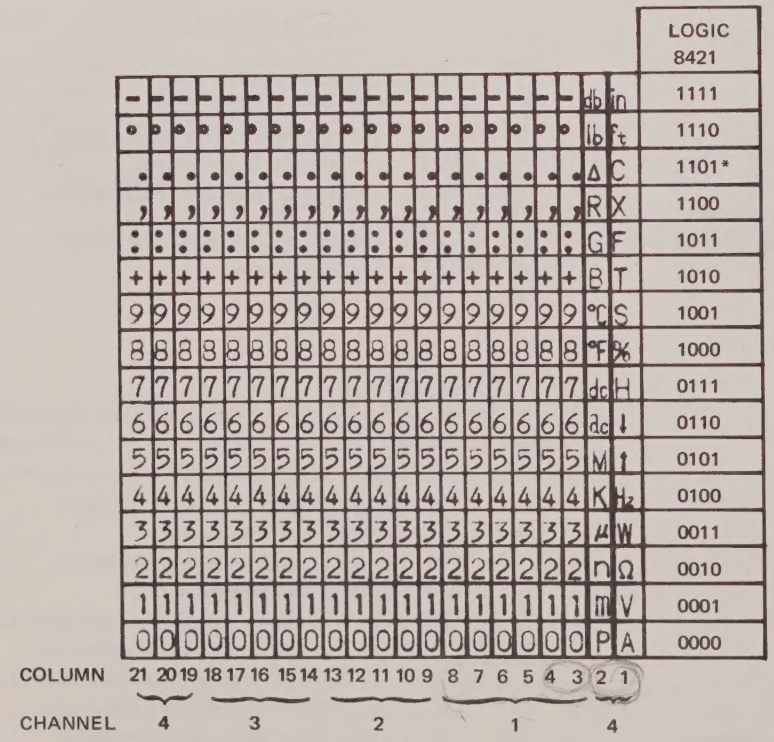
United Systems Corporation
918 Woodley Road
Dayton, Ohio 45403
Phone: 513-254-6251

1.3 Instrument Identification

The instrument model number, serial number, fuse size and power requirement are given on the identification tag on the rear of the instrument.

1.4 Specifications

Printing Speed:	3 lines/second (180 lines/minute) with ribbonless paper 2-1/4 lines/second (135 lines/minute) with standard paper
Column Capacity:	21 columns: 19 data columns plus 2 parameter symbol columns



*Produces blank. Decimal point, Δ, and C are produced by a positive level on the "Decimal Point" line.

Drum Format
Figure 1

Floating Decimal Point:	Available in all 19 data columns. Decimal point is externally activated and appears in the same column and to the right of the data character.
Output Format:	Internally programmable, any input position to any output column.
Print:	Programmable red or black print. Removable ribbon frame to allow use of ribbonless paper.
Paper Requirement:	3-1/2" wide, fan-fold @ 5-5/8" Length 225' nominal. (Receiving tray provided with printer). Internal supply bin loaded via hinged front panel.
Line Spacing:	0.201 ±0.010 inch (5.1±0.25mm)
Character Spacing:	0.138 ±0.004 inch. (3.5±0.1mm)
Power Requirements:	115 or 230 volts, 50 or 60Hz, 50VA
Operating Ambient:	60° to 125°F
Dimensions:	7"H x 7"W x 14"D. Consult factory for rack adaptor kit.
Weight:	Net: 20 lbs. Shipping: 23 lbs.

SYSTEM INTERFACE CHARACTERISTICS

Note: Refer to figure 9 for timing relationships

INPUTS:

Data Inputs:

Must be held true during Hammer Pulse time.

Binary Lines:	1-2-4-8 parallel BCD "1" = +2.0 to +25 volts "0" = -5.0 to +0.5 volts Input resistance = 10K ohms/bit minimum = 20K on 691-_A cards
Decimal Point Line:	"1" = +2.0 to +4.0 volts "0" = -4.0 to +0.5 volts Input resistance = 1K ohms
Print Command Inputs:	A signal applied to any one of these will cause the Printer to print. The type of print command to be used is determined by the user.
Positive Level	+2.0 to +25 volts Input resistance = 10K ohms ±20% Minimum pulse width = 4 milliseconds
Current Sink: Requires current path to ground	"1" = 2.0 to 3.6 milliamps 0 = 0 to 0.5 milliamps Open circuit voltage = 3.6 volts maximum Short circuit current = 3.6 milliamps maximum Minimum pulse width = 4 milliseconds Positive level and current sink print commands provide one-shot action with approximately 2 milliseconds delay and approximately 50 milliseconds recovery.
Positive Pulse:	+2.0 to +25 volts Minimum pulse width 25 microseconds Maximum pulse width 200 milliseconds (for single printed line).
Holdoff: This input is used to prevent the printer from printing. No print command will be accepted in this condition.	+2.0 to +25 volts

Paper Feed:
This input is used to advance the paper without printing. The pulse width determines the number of lines advanced. The tolerances described refer to instrument tolerances and not the tolerance of the input gate. The pulse width per line for any given printer will be constant.

+2.0 to +25 volts

Pulse Width	No. of lines
160-310 milliseconds	1
432-614 milliseconds	2
704-918 milliseconds	3
976-1222 milliseconds	4
1248-1526 milliseconds	5

Red Print:

+2.0 to +25 volts
Input pulse required to print with red ink when using standard paper. Pulse width 40 milliseconds minimum, immediately following the print command.

Channel Inhibit:
(Prevents printing in one channel. 691-_A cards only.

"1" = +2.0 to +6.0 volts
"0" = -5.0 to +0.5 volts
(1KΩ input resistance)

OUTPUTS:

Busy

Positive True:

Current sink mode
"1" = 10 microamps maximum @ 25 volts maximum
"0" = Vce (SAT) 0.35 volts maximum @ 50 milliamps maximum
Voltage level mode
"1" = 3.6 ±0.6 volts open circuit
4.5 milliamps minimum short circuit
"0" = 0.4 volt maximum open circuit

Negative True:

Current sink mode
"1" = Vce (SAT) 0.35 volts maximum
@ 50 milliamps maximum
"0" = 10 microamps maximum @ 25 volts maximum
Voltage level mode
"1" = 0.4 volts maximum open circuit
"0" = 3.6 ±0.6 volts open circuit
4.5 milliamps minimum short circuit

Floating Saturated Transistor:
(Emitter and collector of a transistor, transistor is saturated during a print cycle).

"1" = ON (during busy)
"0" = OFF
Supply voltage = +3.0 to +25 volts (referred to system common)
Load current = 100 milliamps maximum
Voltage drop = 0.5 volts maximum @ 100 milliamps

End of Print:
(Pulse output coincident with the end of a print cycle).

"1" = 2.5 volts minimum open circuit
2.5 milliamps minimum short circuit
"0" = 0.3 volts maximum open circuit
Pulse width of 30 ± 5 milliseconds for standard paper. May be adjusted to approximately 5 milliseconds when ribbonless paper is used.

Character Code BCD:
(A constantly changing BCD output indicating which character is ready for printing at any given time).

"1" = 2.5 volts minimum
"0" = 0.3 volts maximum
Load = 1K ohm minimum

Paper Out:

Positive level coincident with "PAPER OUT" light on the front panel. Indicates when paper reserve is down to one or two folds of paper. Output level is 16 ±2 volts @ 200 milliamps. Printhead hammers are automatically inhibited in this condition.

2. OPERATION

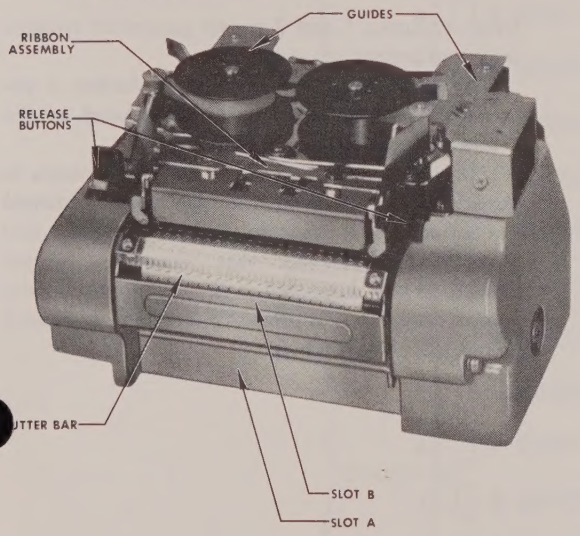
2.1 Precautions

Ensure the external measuring equipment is turned on and is set up per the instructions given in Section 3.

Ensure the ribbon carriage is engaged properly. Ensure there is sufficient paper of the right kind in the paper compartment.

Ensure all cards are completely inserted.

Ensure all rear panel connectors are installed properly, (pins "A" and "1" at the top). Incorrect connection may cause permanent damage to the Power Supply card.

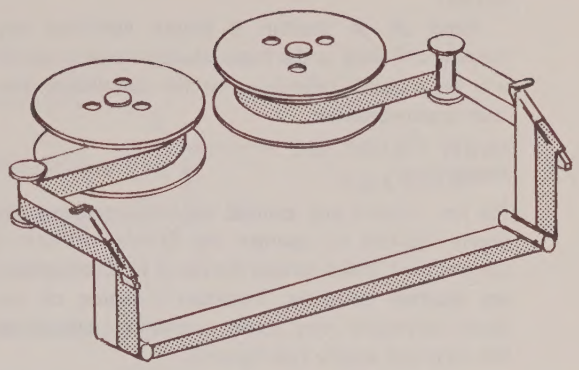


Paper Loading
Figure 2

2.2 Paper Loading (See Figure 2)

To load paper, open the front door by inserting finger into the bezel hole and pulling to release the magnetic latch. Install a pad of fan-folded paper in the paper compartment and depress the POWER button to turn the Printer on. Insert the end of the paper into slot "A" as far as it will go. Then depress the PAPER FEED button until the paper appears at the top of the drum. Pull the clear plastic cutter bar down and again depress the PAPER FEED button until enough paper has been fed to allow insertion into slot "B". After the paper has been inserted under the cutter bar edge, return the paper cutter to the original position. A pad of paper will last for approximately 13000 lines of print and indicate "PAPER OUT" when exhausted.

United Systems Corporation stocks standard (19-11512) and ribbonless (19-12053) paper for this printer. See Section 7 for ordering.



Ribbon Loading
Figure 3

2.3 Ribbon Loading

To load the ribbon, slide out the ribbon assembly by depressing the two black ribbon assembly release buttons and pulling the whole assembly forward. Install the ribbon by following the diagram in Figure 3. Turn the spool until the ribbon is tight. A ribbon will last for approximately 26000 lines.

United Systems Corporation stocks ribbon for this printer; stock number 19-11437-02. See Section 7 for ordering.

For ribbonless paper, remove the entire ribbon assembly. To do this, depress the two black ribbon assembly release buttons as before and pull the assembly forward, then depress the two guides and slide the whole assembly out.

When using ribbonless paper, remove the screw in location "X" on the program card. For maximum printing speed, move screw in location "V" to location "W" and turn R68 (See Section 5) fully clockwise.

3. INSTALLATION

This section is to be used on the initial set-up of the Model 691. It should also be referred to when set-up changes are required. Because it is not known what equipment will be interfaced with this printer, nor the particular system requirements, this section will be limited to covering the 691 capabilities and some typical applications. Additional information is provided on supplement sheets for most standard systems using other DigiTec equipment.

Before proceeding with the installation, read

Section 1 to become familiar with the capabilities of the 691.

Read all of Section 3 before installing any hardware. Filling in the Input/Output form in pencil will be a useful reference, for the installation and later documentation.

3.1 Precautions

Do not remove any printed circuit cards with the power applied or operate the Printer without a control card. Make certain the input card connectors are inserted correctly. Incorrect insertion of the input connector may cause permanent damage to the +3.6 volt supply (see figure 6).

Use extreme caution when connecting two or more inputs or outputs to any common line. Diode isolation must be used in each line on the program card.

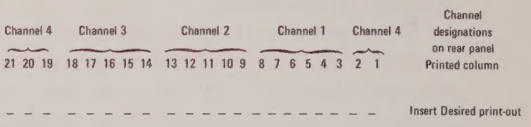
If a positive level (print, holdoff, paper feed, etc.) is used in more than one location, a diode must be used instead of a screw on the program card. Use of the front panel push buttons also produces a positive level.

EXAMPLE: Positive level print is to be connected to pin 1 of channel 1 and pin 1 of channel 2.

Insert a diode in Hole 2D and 3D of the program card. The cathode end of the diode goes to the labeled side of the printed circuit board.

3.2 Output Format

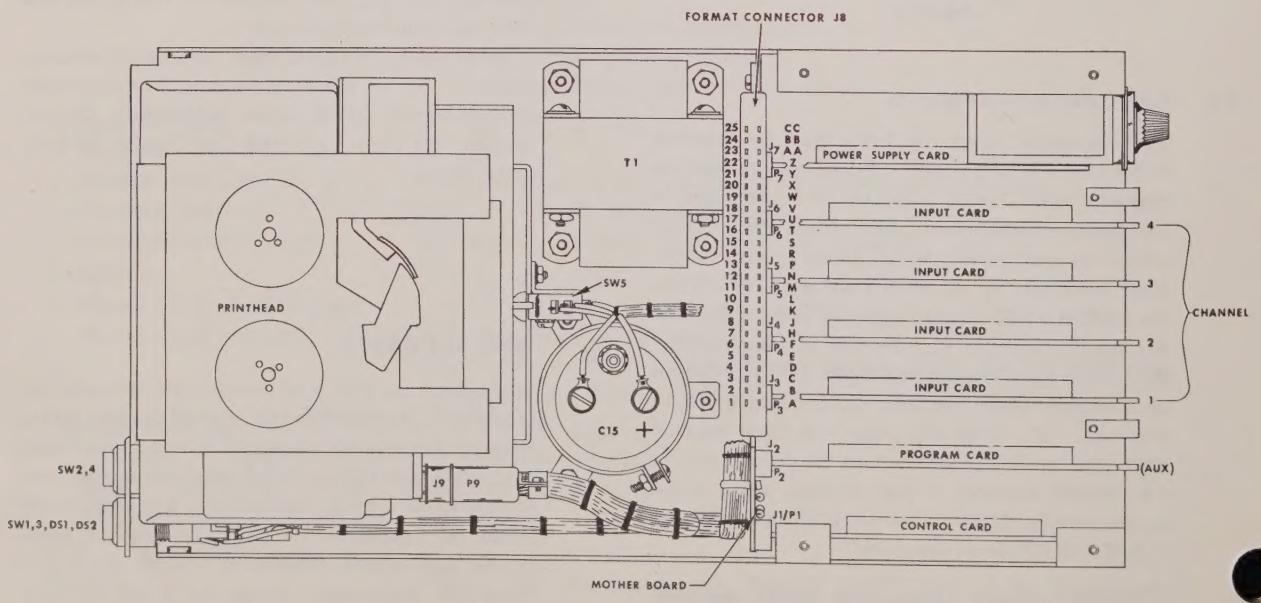
The output format has 21 columns with the two right most containing only parameter symbols. The output format is arranged in four groups, one group (channel) for each input connector. The standard format is as shown below:


Channel 4
Channel 3
Channel 2
Channel 1
Channel 4
Channel designations on rear panel
21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
Printed column
Insert Desired print-out

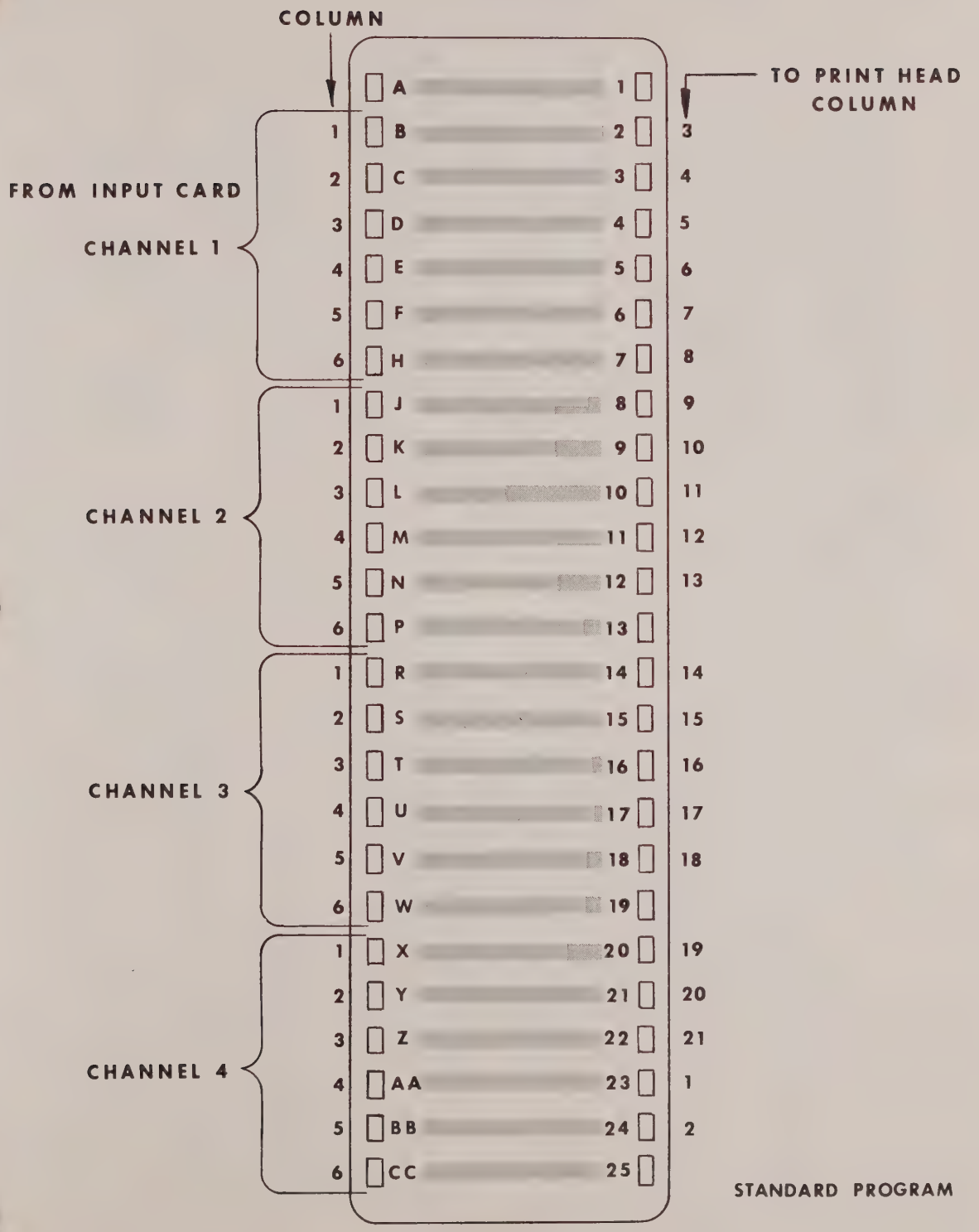
Note: Columns 1 and 2 are for parameter symbols only, and cannot be used for data.

The arrangement of the output format is determined by the format connector located on the Mother Board (See figures 4 and 15).

The standard format connector has jumpers as shown in Figure 5. Special formats can be obtained by removing the standard format connector and installing a 50 pin edge connector, Cinch 251-25-36-160 (supplied) and interconnecting the jumpers as desired. By proper connections, any input to output can be achieved.



Top View of Printer
Figure 4



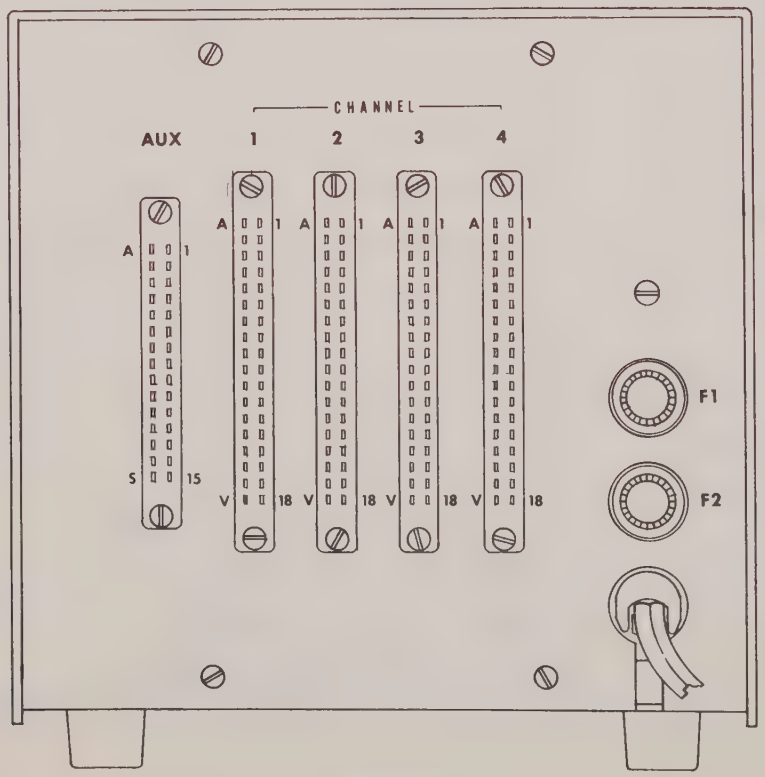
Format Connector
Figure 5

3.3 Input Connections

Each channel is controlled by an input card with up to 6 columns per card. The connectors located on the rear of the printer labeled Channel 1, 2, 3, and 4 are connected directly to the input cards. Input connections are shown below:

FUNCTION		PIN
Column 1	BCD "1"	U
Column 1	BCD "2"	V
Column 1	BCD "4"	17
Column 1	BCD "8"	18
Column 1	Decimal Point	F
Column 2	BCD "1"	S
Column 2	BCD "2"	T
Column 2	BCD "4"	15
Column 2	BCD "8"	16
Column 2	Decimal Point	E
Column 3	BCD "1"	P
Column 3	BCD "2"	R
Column 3	BCD "4"	13
Column 3	BCD "8"	14
Column 3	Decimal Point	D
Column 4	BCD "1"	M
Column 4	BCD "2"	N
Column 4	BCD "4"	11
Column 4	BCD "8"	12
Column 4	Decimal Point	C

FUNCTION		PIN
Column 5	BCD "1"	K
Column 5	BCD "2"	L
Column 5	BCD "4"	9
Column 5	BCD "8"	10
Column 5	Decimal Point	B
Column 6	BCD "1"	H
Column 6	BCD "2"	J
Column 6	BCD "4"	7
Column 6	BCD "8"	8
Column 6	Decimal Point	A
Auxiliary Functions (See Section 3.4)		1,2,3,4
+3.6 volt supply		6
Common		5



Rear Panel
Figure 6

INPUT/OUTPUT FORM

INPUTS

Type of print command used:

1. Positive level true
2. Positive pulse true
3. Current sink

Holdoff

Red Print

External Paper Feed

OUTPUTS

Busy: Positive true

Voltage level

Current sink

Negative True

Voltage level

Current sink

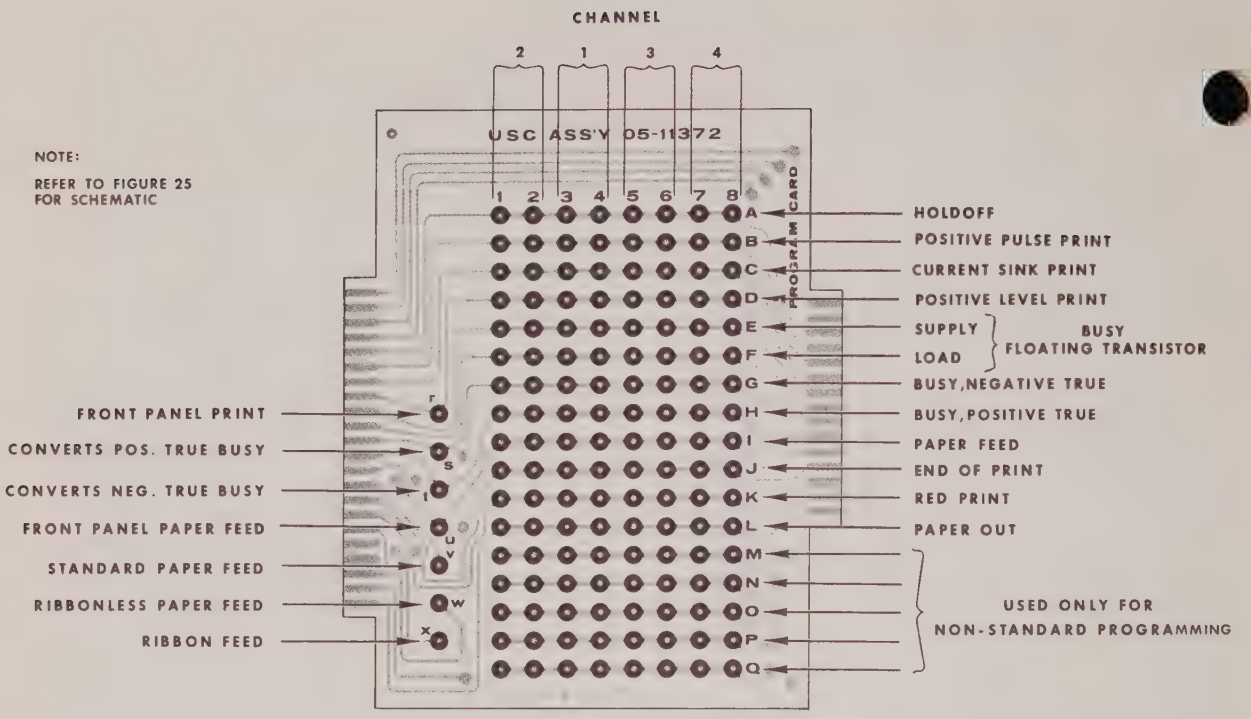
Floating Saturated Transistor

End of Print

Character Code

Paper Out

Source of Input/Output						Model	Pin No.
Voltmeter	Scanner	Clock	Thermometer	Other ___			



Program Card
Figure 7

INTERNAL PROGRAMMING

*r — allows the front panel print button to be disabled. Insert screw for front panel operation.

s — converts negative true busy from current sink mode to logic level mode. Insert screw for logic level mode.

t — converts positive true busy from current sink mode to logic level mode. Insert screw for logic level mode.

*u — allows the front panel paper feed button to be disabled. Insert screw for front panel operation.

*v — insert screw for standard paper feed.

w — insert screw for self-contained paper.

*x — insert screw for ribbon feed (standard paper feed only).

*Printers are shipped for use with standard paper. Screws are inserted into holes r, u, v and x.

3.4 Programming

This printer is equipped with a printed circuit program card. By properly programming this card, it is possible to have any four of the auxiliary functions (as shown in Figure 7) connected to any of the four input channels using pins 1 through 4.

Programming is determined by the requirements as indicated on the preceding input/output form. A few programming examples are shown below:

Positive pulse print — to bring the positive pulse print to pin 1 of channel 1, insert a screw, with washers, into hole 3B.

Busy Floating Transistor — this output requires an external load and a supply voltage. The supply may be external or, if desired, from the +16 volt supply located on the auxiliary connector. To connect the +16 supply to the supply input, install a jumper from pin 14 to pin "H" on the auxiliary connector. The load side is connected by inserting a screw in Row "F" under the desired column.

Ground — to bring ground out to the auxiliary connector, add a jumper on an input card connector from pin 5 to one of the unused auxiliary pins (pins 1, 2, 3 or 4), then insert a screw in one of the unused "non-standard" rows (M through Q) of the progr card.

All of the function lines on the program card are available on the rear panel AUX connector. Nor-

mally, this connector is not required, but it can be used if additional external programming is desired. The connections are shown on figure 25 and are listed below:

PIN		FUNCTION
1		Not connected
2		Character Code, BCD "1"
3		Character Code, BCD "4"
4		Character Code, BCD "2"
5		Character Code, BCD "8"
6		Not connected
7		Not connected
8		Not connected
9		Special Jumper
10		Special Jumper
11		Special Jumper
12		Special Jumper
13		Special Jumper
14		+16 volts @ 1 amp
15		Not connected
A		Not connected
B		Not connected
C		Holdoff
D		Positive Pulse Print
E		Current Sink Print
F		Positive Level Print
H	Supply	Busy, Floating Transistor
J	Load	
K		Busy, Negative True
L		Busy, Positive True
M		Paper Feed
N		End of Print
P		Red Print
R		Paper Out
S		Not connected

3.4.1 BLANK SPACES. Blank spaces may be obtained by using any one of the following methods:

1. Using an input card with less columns than the standard format requires:

   A five-column card in Channel 1 will produce a blank in printer column 8.

   A four-column card in Channel 2 will produce a blank in printer column 13.

   A four-column card in Channel 3 will produce a blank in printer column 18.

2. Programmed Blank:

   A column can be programmed for a blank by providing a Binary 13. This may be accomplished by tying the binary input 1, 4, and 8 to +3.6 volts (pin 6 of an input card). On 691-_A cards, jumpers can be made directly on the printed circuit card or the rear connector.

3. Format Blank:

   The standard format connector connects an input card column to each printhead column. By replacing the standard format connector with the double row connector (Cinch 251-25-36-160) supplied, these connections are broken. Jumpers may then be placed on the double row connector to produce printing in only the desired columns. All columns left disconnected will be blank.

3.4.2 FLOATING DECIMAL POINT. This printer has provisions for producing a decimal point in any of the 19 data columns (columns 3 through 21) to the right of the data digit. This is accomplished by printing twice in the same column. To print a decimal point, apply +2.0 to +4.0 volts to the desired decimal line. These lines can be driven by the measurement instrument, if decimal point output is available, or can be hardwired. The hardwired jumper can be made on the connector, or on the printed circuit board on the 691-_A cards. This requires jumpering the +3.6V to decimal point 1, 2, 3, 4, 5 or 6.

3.4.3, DOUBLE STRIKE PRINTING. Some applications require that two input columns be printed in the same column, such as a comma alongside a number, or combining two standard symbols to obtain a special symbol, such as "—" and ":", producing "÷". To produce a double strike, connect the input of two columns on the format connector to the input of one printhead column.

3.4.4 PARAMETER SYMBOLS AND CONTINUOUS CHARACTER PRINTOUT. Special characters appearing in columns 1 and 2 or any data character, such as ":" or "°" may be permanently installed by connecting +3.6 volts to the appropriate binary lines (see figure 1). The +3.6 volts is available on pin 6 of the input connectors. On 691-_A cards, jumpers may be made on the printed circuit card or on the rear connector. Any character, data or special, can be externally activated by applying the proper BCD to the desired column. To maintain a polarity indication, hardwire a binary 2 and 8 to +3.6 to provide a constant + symbol. To obtain a – symbol, binary 1 and 4 must be added to the polarity bit

input, making a logic 1, 2, 4, 8 which is a minus symbol. The Δ and C printouts are produced with the decimal line and are not treated as normal characters (see Section 3.4.2).

3.4.5 CHANNEL INHIBIT. On 691-_A cards, it is possible to inhibit an entire channel without affecting other channels. This is accomplished by putting a drop of solder between the CH. INHIBIT pads and applying a +2 to +6 volt level to pin 4. Channel inhibit cannot be used when pin 4 is being used for another application.

4. CIRCUIT DESCRIPTION (See figs. 8 and 9)

The block diagram shown on figure 8 can be divided in two parts for a brief explanation. The top half of the circuitry blocks are used to synchronize the hammer strike with the drum rotation. To print the correct character, the input BCD must be synchronized with the drum position when the hammer strikes. This synchronizing is in constant process but cannot trip the hammer until it is enabled by the Cycle Synchronizing Flip-flop, as a result of a print command.

The bottom half of the circuitry blocks receive the print, holdoff, red ribbon, or paper feed inputs. A print command is the start of any given cycle. After a print command, the ribbon color is select[illegible] and then the hammer pulses are enabled. Th[illegible] hammer pulses are counted for one complete drum revolution, producting an end of print pulse, advancing the paper and ribbon, and returning the printer to the pre-print command state.

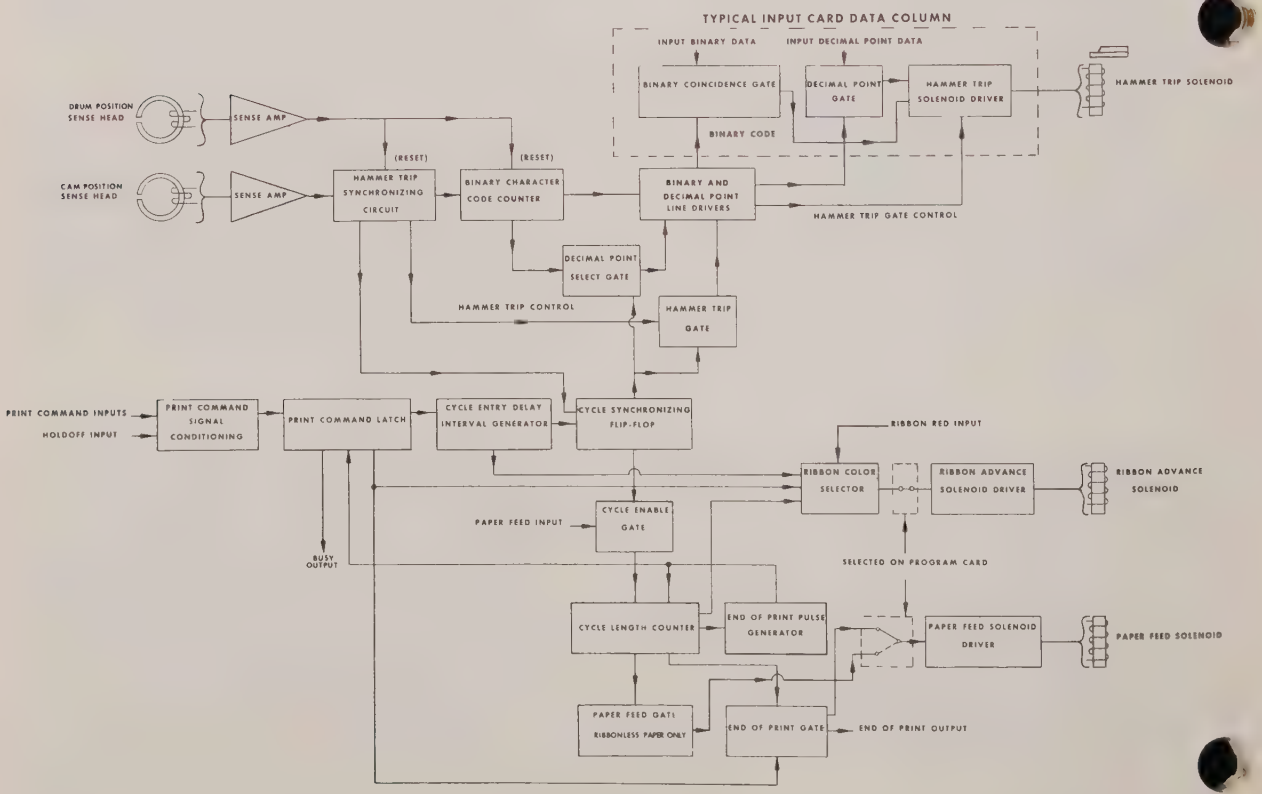
4.1 Mother Board (See figures 15 and 16)

The Mother Board provides interconnecting wires, printed circuit conductors, and mating receptacles for all the cards, format connector, front panel switches, off board components, and the printhead used in the Model 691.

Resistor R179 and diode D26 are in series from the +3.6 volt supply to ground. The +0.6 volt diode drop is used to bias the input cards. 691-_A input cards do not require the +0.6V bias supply. Capacitors C12 and C14 are across +3.6 and +16 volt supply respectively. Capacitor C13 is used to filter any spikes or noise to chassis ground.

4.2 Control Card (See figures 17, 18, and 19)

The basic function of the Control Card is to make the appropriate hammer strike the drum at the time when the proper character is in position.



Block Diagram
Figure 8

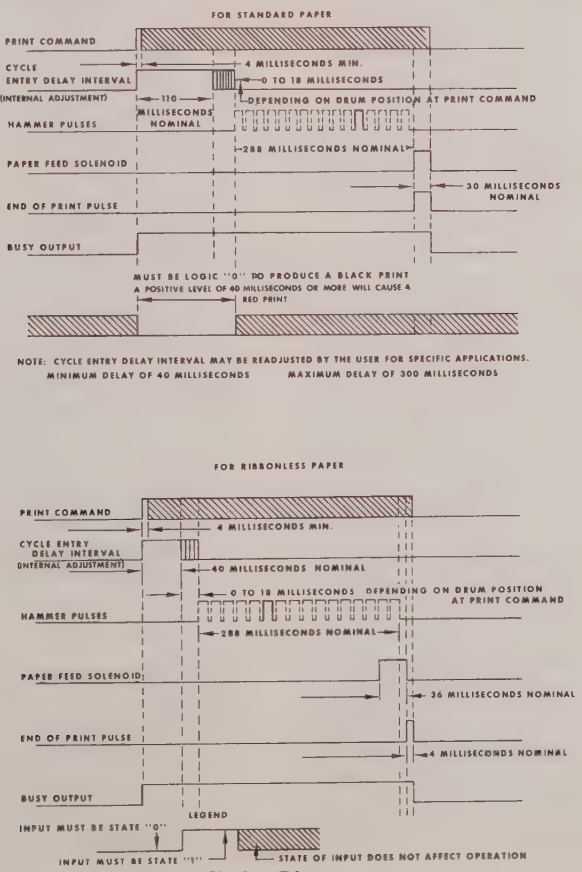
4.2.1 DRUM POSITION SENSE AMPLIFIER. The input pulse from the Printhead to the Drum Position Sense Amplifier is approximately one-half volt and occurs once for every complete drum revolution. The amplifier's output is approximately three volts and serves as a reset (logic 0000) for the Binary Character Code Counter. This reset pulse occurs when the "0" character on the drum faces the hammers.

4.2.2 CAM POSITION SENSE AMPLIFIER. The input pulse from the Printhead to the Cam Position Sense Amplifier is approximately one-half volt and occurs twice for every Cam revolution. (The Cam revolves once per drum line, or sixteen Cam revolutions for each Drum revolution). The output pulses of this amplifier are approximately three volts and are fed to the Hammer Trip Synchronizing Circuit.

4.2.3 HAMMER TRIP SYNCHRONIZING CIRCUIT. The reset pulse (TP 2) from the Drum Position Sense Amplifier resets ICla through IC3 to logic zero (Q-low). The output pulses from the Cam Position Sense Amplifier are applied to the toggle input of ICla, making ICla switch logic states with each pulse. The $\overline{Q}$ output of ICla is a positive pulse with a width equal to the distance between two Cam pulses (inverted test point 3). This $\overline{Q}$ output pulse will occur once for each drum line (sixteen times per drum revolution).

4.2.4 BINARY CHARACTER CODE COUNTER. The $\overline{Q}$ output of ICla is applied to the toggle input of ICIb, the least significant J-K flip-flop of the counter. The $\overline{Q}$ output of each J-K flip-flop is applied to the toggle of the next most significant J-K flip-flop. There are four J-K flip-flops thus making a total possible count of sixteen, from 0000 (logic zero) to 1111 (logic fifteen). The logic count always agrees with the character on the drum that faces the hammers.

4.2.5 BINARY AND DECIMAL POINT LINE DRIVERS. The Binary Line Drivers are transistor inverters that provide a positive output to the Input Cards corresponding to the binary count (drum position) on the Binary Character Code Counter. The Decimal Point Line Driver (Q9) provides a positive level except when the drum is in the decimal point position (1101-logic 13).


FOR STANDARD PAPER
PRINT COMMAND
CYCLE ENTRY DELAY INTERVAL (INTERNAL ADJUSTMENT)
4 MILLISECONDS MIN.
0 TO 18 MILLISECONDS DEPENDING ON DRUM POSITION AT PRINT COMMAND
110 MILLISECONDS NOMINAL
HAMMER PULSES
288 MILLISECONDS NOMINAL
PAPER FEED SOLENOID
30 MILLISECONDS NOMINAL
END OF PRINT PULSE
BUSY OUTPUT
MUST BE LOGIC "0" TO PRODUCE A BLACK PRINT
A POSITIVE LEVEL OF 40 MILLISECONDS OR MORE WILL CAUSE A RED PRINT
NOTE: CYCLE ENTRY DELAY INTERVAL MAY BE READJUSTED BY THE USER FOR SPECIFIC APPLICATIONS.
MINIMUM DELAY OF 40 MILLISECONDS
MAXIMUM DELAY OF 300 MILLISECONDS

Timing Diagram
Figure 9

4.2.6 DECIMAL POINT SELECT GATE. This gate consists of a six-input NOR. The output is logic zero (low) unless all six inputs are low. The high output only occurs when the drum is in the decimal point position (1101-logic 13) during a print cycle.

4.2.7 HAMMER TRIP GATE. This gate consists of a three-input NOR driving Q26 and Q27. The output of IC10b is low unless all three inputs are low. When all three inputs are low, the output (TP L) goes high turning on Q26 and Q27, and providing a high output on pin 35 to the input cards.

The input on pin 8 of IC10b (TP K) is low only during the print time of a print cycle. The input on pin 6 (TP E) is normally low and only goes high when the drum is in the decimal point position. The input on pin 7 (TP 3) goes low when a character line on the drum faces the hammers. This last input insures precise timing of the Hammer Trip pulse.

4.2.8 PRINT COMMAND SIGNAL CONDITIONING. A print command can be initiated in any of three ways: (1) Positive pulse, (2) Positive level, or (3) Current sink. Refer to 1.4 Specifications for required print command inputs. A positive pulse applied to P1 pin 11 will be integrated by R38 and C8. When Q14 turns on, a positive pulse will be fed to IC5a pin 1.

A positive level on P1 pin 13 or a current sink to ground on pin 12 will tend to turn Q11 on. However, as collector of Q11 goes positive C1 will hold Q11 off. This produces an active delay of approximately 2 milliseconds. At the end of this period, Q11 turns on and in turn Q13 turns on.

The output of Q13 is differentiated by C4 and R35, and the resulting positive pulse is fed to IC5a pin 1. Q11 will remain on until approximately 50 milliseconds after the positive level or current sink has been removed, due to current supplied to the base by C1.

The print pulse at pin 1 of IC5a will not exist when a positive level is applied to P1 pin 10, because Q15 will ground all pulses during a "holdoff" condition.

4.2.9 PRINT COMMAND LATCH. The latch consists of two cross coupled NOR gates. When a positive pulse is applied to pin 1 of IC5a, the output (pin 3) goes low. Pin 13 of IC5d is normally low (through R69) and when pin 12 of IC5d goes low, the output (pin 14) goes high. The latch will remain in this state (pin 3-low, pin 14 high) until pin 13 goes high from the end of print pulse. This switches pin 14 to low and pin 3 to high. The latch will remain in this state until another print pulse is received.

4.2.10 CYCLE ENTRY DELAY INTERVAL GENERATOR. Transistors Q21 and Q22 are off and Q20 is on prior to receiving a print command. With Q20 on, C2 is kept in the discharged state while Q23 is held off, providing a low input on pin 9 of IC6c. IC6c and IC6b act as a latch similar to the Print Command Latch. When test point 7 goes low, Q20 is turned off, and C2 begins to charge. The rate of charge is determined by the setting of R54. This adjustable delay time is nominally set for 110 milliseconds but can range from approximately 40 milliseconds to 300 milliseconds. When Q23 does turn on, pin 9 of IC6c (TP H) receives a positive pulse. This switches pin 8 (TPJ) to low and IC6b pin 5 to high. IC6c and IC6b will remain in this state until pin 7 of IC6b is driven high by the Q output of IC9a (TP 6). (See 4.2.13)

4.2.11 CYCLE SYNCHRONIZING FLIP-FLOP. Prior to a print command, the Q output of IC7b (TP M) is low. The flip-flop is held in this low Q state by the high "reset" input to pin 10 (TP J) from IC6c pin 8. A low input on pin 10 of IC7b enables the flip-flop to switch when a negative going edge is applied to pin 6. The input to pin 6 of IC7b is test point 3, which receives a cam pulse ever 18 milliseconds. Therefore, IC7b will switch states within 18 milliseconds of pin 10 going low. When pin 8 of IC6c goes low, pin 5 of IC6b goes high. This holds IC7b in the "set" (Q high) condition even though pulses are continuously applied to pin 6.

4.2.12 CYCLE ENABLE GATE. This gate consists of three NOR gates and a non-inverting buffer Q28. Prior to either a print command or a paper feed command, IC5c pins 9 and 10 are low making pin 8 high (TP P). After a print command, pin 10 goes high driving pin 8 low enabling the Cycle Length Counter. A paper feed positive input to P1 pin 19 will drive IC5c pin 9 high also causing the counter to be enabled.

IC6d pin 14 (TP N) is high prior to receiving either a paper feed or a print command by way of IC7b. When either command is given, pin 14 goes low enabling IC6a to put out a positive pulse for each pulse into pin 1. This IC6a pin 3 output (test point 4) is therefore an inverted test point 3 when either a print command or a paper feed has occurred. These pulses are fed to the Cycle Length Counter.

4.2.13 CYCLE LENGTH COUNTER. The pulses (TP 4), one for each character line on the drum, are fed to the toggle input of the least significant J-K flip-flop (IC7a). The binary logic state of the counter corresponds to the number of character lines com

pleted. [i.e. counter equals 1000 (binary 8) 8 characters have passed the hammers and 8 characters remain. Therefore, the drum has made one-half revolution]. The Q output of IC9a (TP 6) is low until the Q output of IC9b goes low causing IC9a to toggle, indicating all sixteen drum characters have been counted. This resets IC6b, IC6c, and IC7b.

4.2.14 END OF PRINT PULSE GENERATOR. The $\overline{Q}$ output of IC9a (TP W) goes low after the sixteenth count. This turns off Q24 allowing C5 to charge. The charging rate is determined by R68. When Q25 fires (nominally 30 milliseconds delay) a narrow positive pulse (TP X) resets IC9a and the Print Command Latch. The pulse generator will only fire once per print cycle because Q24 is held on when IC9a is in the reset state.

4.2.15 END OF PRINT GATE. This gate consists of two transistors, Q33 and Q34. The transistors function as a NOR gate; requiring two low inputs to receive a high output on P1 pin 21. This high output is the end of print pulse and can be set for 30 milliseconds for standard paper and 5 milliseconds for ribbonless paper, as determined by R68 in the end of print pulse generator.

4.2.16 BUSY INTERFACE BUFFERS. The buffers provide outputs to external equipment when the printer is "busy". There are three available busy signals: (1) Positive True, (2) Negative True, (3) Floating Transistor. The positive true busy is provided by Q17, which is turned off during busy. This can be used as a current sink or as a voltage level by adding a collector load to the transistor. The selection is made on the Program Card. The negative true busy is provided by Q16 which is turned on during busy. It too, can be either a current sink or voltage level determined by the Program Card. The floating transistor is Q19, which is switched by Q18. Transistors Q18 and Q19 require positive supply voltage (referred to system common) on P1 pin 15, and a load connected from P1 pin 16 to system common. Transistors Q18 and Q19 are turned on during busy.

4.2.17 PAPER FEED SOLENOID DRIVER. The input to the paper feed solenoid driver is on P1 pin 28. This input is jumpered through the Program Card from either P1 pin 20 (standard ribbon paper) or P1 pin 33 (ribbonless paper). The solenoid driver provides a ground return activating the solenoid when a positive pulse is applied to P1 pin 28. For standard paper, this positive pulse comes from Q33 which is turned off during the end of print pulse. The paper is advanced when the solenoid is released at the end of the pulse.

4.2.18 PAPER FEED GATE FOR RIBBONLESS PAPER. This gate consists of one three input NOR gate, IC10a. This gate (TP V) will provide a positive pulse (engaging the solenoid) only when all three inputs are low (binary 2, 4, & 8). On the next binary count, the inputs go high causing a low output and releasing the solenoid, thus advancing the paper.

4.2.19 RIBBON COLOR SELECTOR. The three-input NOR gate IC10c puts out a positive pulse (TY P) only when all inputs are low and Q30 is off. A low input on P1 pin 24 keeps Q29 off and Q30 on, clamping IC10c pin 9 to ground. To select a red ribbon print, there must be a high input on P1 pin 24. All three inputs to IC10c are low at the beginning of a print cycle (during cycle entry delay). This causes a positive output which is jumpered through the Program Card to the Ribbon Advance Solenoid Driver.

4.2.20 RIBBON ADVANCE SOLENOID DRIVER. When a positive pulse is fed into P1 pin 32, Q31 and Q32 switch on, providing a ground return for the ribbon solenoid. When this ground is present, the solenoid moves the ribbon out into the red position. The ribbon is mechanically held in the red position until the paper is advanced, at which time the ribbon is released and is advanced, and returned by a spring to the black position. Therefore, if the positive pulse is received by Q31 before the actual printing, that line will be in red.

4.3 Program Card (See figures 24 and 25)

The Program Card connects to the mother board on one end and to the rear panel AUX connector on the other, and serves as an interconnect matrix for the entire printer. Connections are made by inserting screws through prepunched holes in the double sided printed circuit board.

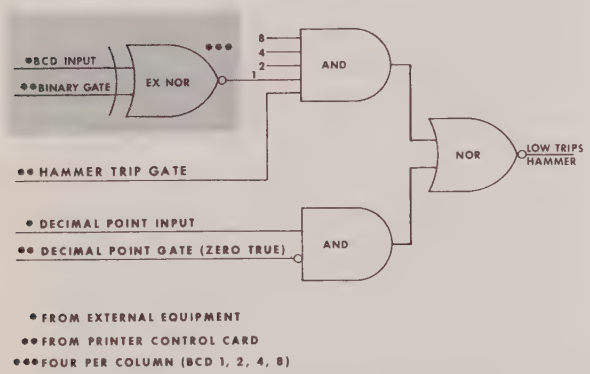
4.4 Input Card (See figures 26 through 29)

The Input Cards received the BCD and decimal point inputs from external equipment. These connections are made directly to each Input Card on the rear panel.

Timing pulses from the Control Card representing drum position are fed to the Input Cards. When coincidence occurs between the external input and timing pulses (binary gates and hammer trip gates) the logic circuits on the Input Cards provide a ground return to the hammer solenoid on the printhead.

Input Cards are made containing either 4, 5 or 6 columns. There is one Input Card column for each printed column. The circuitry for all columns is identical, only the termination points on connectors are different.

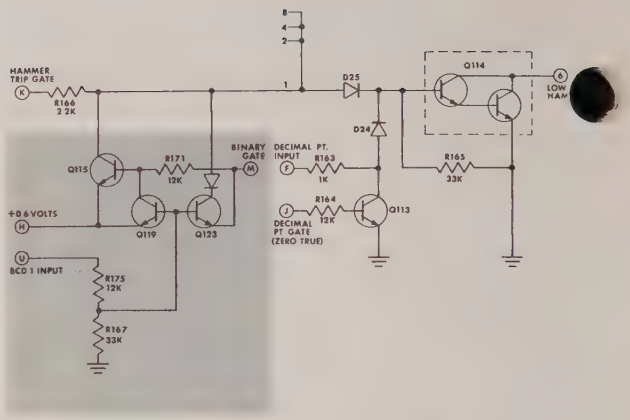
4.4.1 MODEL 691-1, 2, 3 INPUT CARD (See figures 10 and 11). Each column consists of four Exclusive NOR gates, two AND gates, and one NOR gate. Each of the Exclusive NOR gates compares the external BCD Input and the Binary Gate from the Control Card for one binary line (1, 2, 4, or 8). The output of an Exclusive NOR will be a logic one when both inputs are low or when both inputs are high. These four outputs and a Hammer Trip Gate are fed to an AND gate. For the AND gate output to be high, all five inputs must be high. When the AND gate output is high, the NOR gate output is low, which trips the hammer solenoid. The other input to the NOR gate is a logic one when the external Decimal Point Input is one and the Decimal Point Gate from the Control Card is zero.



691-1, 2, 3 Input Card Logic Diagram
Figure 10

Figure 11 shows a partial schematic of column one of one card. The schematic shows in detail what is represented by the logic diagram. Only one Exclusive NOR is shown, but all four must be true to enable the AND function. In detail, the enabling is accomplished by *not* clamping the Hammer Trip Gate to ground. To keep Q123 from clamping, it must be held off by either a high on the Binary gate input or a low on the BCD input. To keep Q115 from clamping, it must be held off by keeping its base low. This can be done in two ways; (1) A low input on the Binary gate, or (2) Turning on Q119 with a high BCD input. The result of this circuitry is to clamp (inhibit) the Hammer Trip Gate when the BCD input and the Binary gate are different.

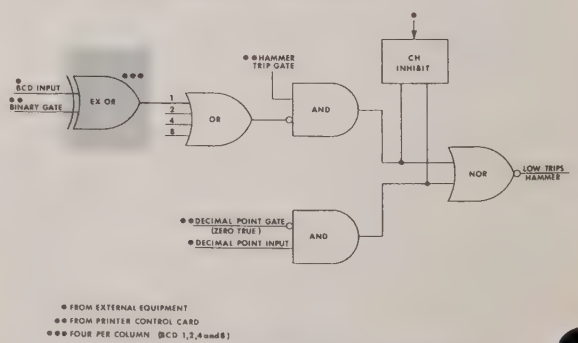
The decimal point AND gate will provide a high



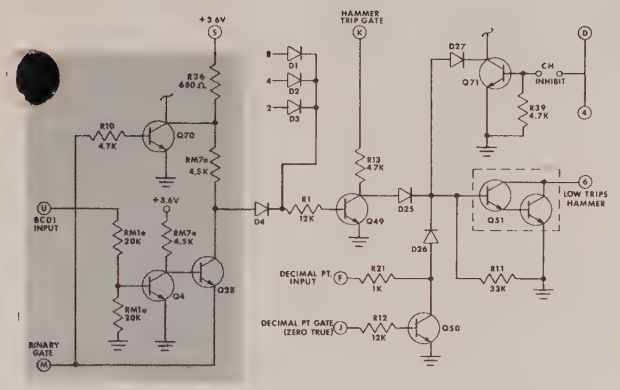
691-1, 2, 3 Partial Schematic
Figure 11

output when the Decimal Point input is high and the Decimal Point gate is low (Q113 off). The Decimal Point gate is low when the drum is in the decimal point position.

4.4.2 MODEL 691-1A, 2A, 3A INPUT CARD (See figures 12 and 13). Each column consists of four Exclusive OR gates, one OR gate, two AND gates, and one NOR gate. Each of the Exclusive OR gates compares the external BCD Input and the Binary Gate from the Control Card for one binary line (1, 2, 4, or 8). The output of an Exclusive OR will be a logic z when both inputs are low or when both inputs are high. These four outputs are fed to an OR gate. The OR gate output is fed to an inverted input of an AND gate. For the AND gate output to be high, the OR output must be low and the Hammer Trip Gate must be high. When the AND gate output is high, the NOR gate output is low which trips the hammer solenoid. The other AND gate provides a high output when the external Decimal Point Input is one and the Decimal Point Gate from the Control Card is zero. The Channel Inhibit is controlled by input pin 4 when used, and when activated will clamp the two AND gate outputs to logic zero.



691-_A Input Card Logic Diagram
Figure 12



691-_A Partial Schematic
Figure 13

Figure 13 shows a partial schematic of column one of one card. The schematic shows in detail what is represented by the logic diagram. Only one Exclusive OR is shown, but all four must be true to enable the AND function. In detail, the enabling is accomplished by *not* clamping the Hammer Trip Gate to ground. To keep Q49 from clamping, it must be held off with a low level on its base. (A positive level through D1, 2, 3, or 4 will inhibit the Hammer Trip Gate). One condition that a low level is provided through D4 is when Q28 is on. This occurs when the Binary Gate input is low and the BCD input is low. The only other condition a low is provided by D4 is when Q28 is off and Q4 and Q70 are on. This occurs when both inputs are high. In the condition where the BCD input is high, and the Binary gate is low, Q4 is on holding Q28 off, and Q70 is off, permitting the +3.6 volt to hold D4 high through R36 and RM7a. The fourth condition is when the BCD input is low and the Binary gate is high. This holds Q28 and Q4 off and Q70 on. The base to collector PN junction of Q28 acts as a diode with forward bias carrying current from the +3.6 volt supply through RM7e, RM7a, and Q70 to ground. This voltage divider provides a high to D4 keeping Q49 on.

The decimal point AND gate will provide a high output when the Decimal Point input is high and the Decimal Point gate is low (Q50 off). The Decimal Point gate is low when the drum is in the decimal point position.

The Field Inhibit capability is provided by turning on Q71 with a positive input. The entire card will be inhibited during the time that Q71 is on.

4.5 Power Supply Card (See figures 20 through 23)

The Power Supply Card receives the AC line power, steps down and rectifies the AC voltage, and provides regulated DC voltages to the rest of the circuitry and the printhead.

Because of physical size and convenience, T1, C15, and SW1 are not mounted on the card. The wiring to these components is through the Mother Board (See figure 15).

The 28Vrms output on T1 pins 5 and 9 is rectified by D7 and D8. Capacitor C15 smooths the pulsating DC. Power transistor Q42 is biased on by Q38 and Q39, providing a positive 16 volt output, based on zener diode D13 which provides a 16 volt reference. Q37 provides active current limiting.

The 9Vrms output on T1 pins 6 and 8 is rectified by D9 and D10 and stored by C11. Transistor Q40 is biased on by Q41 with the base of Q41 being referenced by zener diode D11. On the type 2 card, Q72 and Q73 provide active current limiting of the 3.6 volt supply.

4.6 Format Connector (See figure 16)

The Format Connector is a dual-row edge connector that mates P8 on the Mother Board. The function of the Format Connector is to connect the hammer drive signals from the front of the Mother Board to the rear side of the Mother Board. A standard Format Connector (jumpered directly across) is provided with the printer. Also a "not programmed" connector is provided. This enables a complete selection of arrangement of input columns to output (printed) columns.

5. CALIBRATION

The only calibrations for the Model 691 are the adjusting of R54, Cycle Entry Delay Interval and R68, End of Print Pulse. These resistors are accessible from the right side with the top cover removed.

The Cycle Entry Delay Interval is factory set for 110 milliseconds to allow the measuring instrument sufficient stabilization time before printing. If the measuring instrument requires less time, R54 can be adjusted to a minimum of 40 milliseconds. This adjustment can be made by programming a red print, turning R54 fully clockwise (stops printing red) and then turning R54 counter-clockwise until a red print is consistent.

To do this, disconnect all inputs to the printer. Jumper +3.6 volts from pin 6 on an input card to pin P on the AUX connector to cause a red print. Depress the "PRINT" button approximately once per second.

To increase the Cycle Entry Delay, turn R54 counter-clockwise. For precise measuring of Cycle

Entry Delay, an oscilloscope is required, but for a close approximation, the following procedure can be used. Connect a jumper from pin 6 of any input card to AUX pin D. Turn on the printer and let it run for 30 seconds. Count the number of printed lines and readjust as needed. This procedure assumes that the end of print pulse is 30msec.

No. of Lines	Approximate Delay
75	70 milliseconds
68	110 milliseconds
60	170 milliseconds
50	270 milliseconds.

The End of Print Pulse delay is factory set for 30 milliseconds. This setting should only be readjusted if ribbonless paper is used or if the paper or ribbon does not advance properly. For readjustment using standard paper, turn R68 fully clockwise and slowly turn R68 counter-clockwise until the ribbon feeds positively. For ribbonless paper, turn R68 fully clockwise.

6. MAINTENANCE

6.1 Troubleshooting Hints

Due to the complexity of control board, troubleshooting section covers board level maintenance only. A problem associated with a specific column may be traced to one or more columns on one of the input cards. The column positions are denoted both on the input card schematic and on the pictorial. Other problems will normally be caused by defective power supply, improper programming or a defective control card.

Detailed troubleshooting of the control may be expedited by referring to the waveshape timing diagram in figure 17.

Equipment required for detailed troubleshooting are:

1. Voltmeter – accuracy of ± 2%, capable of measuring 20VDC
2. Oscilloscope – with triggered sweep; such as Tektronix Model 503

If service equipment of the required accuracy is not available, the instrument may be returned to United Systems Corporation for repair or recalibration.

SYMPTOMS	POSSIBLE CAUSE
Unit completely dead	Blown fuse (F2), power supply card not plugged in, power applied at plug, loose or defective contact block on front panel "POWER" switch.
Printer does not print but front panel lights illuminate	Low on paper, format connector loose or missing, missing program card, screw missing or loose in hole "r" of the program card, printhead connector loose. Defective power supply card, defective printhead (do not replace printhead if +16 volt supply higher than 18 volts).
Front panel push button, does not produce a print command, but external command operates normally	Screw missing or loose in hole "r" on program card
Printhead turns excessively fast, characters are smeared	+16 volt supply too high on power supply card. Do not operate in this condition.
Printhead turns slowly, front panel lights not illuminated, unit does not operate	+16 volt supply too low, blown fuse (F1)
Holes punched in paper or ribbon	Control card not completely plugged in. Defective input card (note the defective column and troubleshoot the appropriate card and column).
One or more columns missing but not all columns	Loose or dirty format connector, defective input card
Wrong character being printed	Measuring instrument (input data) is not in store or hold position (i.e. data is changing during print cycle). Defective input card, defective control card.
Random missing character(s). Missing character(s) are absent in all columns on one printed line.	Low on paper, paper not fully inserted in paper tray, paper out switch defective. May be corrected by bending feeler bar of switch.
Two characters print red intermittently when printout should be black	Screw in the program card is in the wrong location. Screw should be in hole "v", not in hole "w" for standard paper.

SYMPTOMS	POSSIBLE CAUSE
Multiple printing in one or more columns but not all columns	Defective input card. Measuring instrument (input data) is not in store or hold position (i.e. data is changing during print cycle).
Multiple printing in all columns	Missing screw in either hole "v" or "w". End of print pulse out of adjustment (see section 5). Defective control card.
Character does not print completely or prints half red and half black	Ribbon carriage not fully engaged, see section 2.3.
Printout gets lighter with time using standard paper	Screw missing or loose in hole "x" on program card. Worn ribbon
Ribbon does not advance	Screw missing or loose in hole "x" on program card. R68 out of adjustment, see section 5.
Front panel paper feed button does not advance the paper, printer operates correctly otherwise.	Screw missing or loose in hole "v" on program card.
Printer will not print red	Screw missing or loose in column "k" on program card. Cycle entry delay out of adjustment (see section 5).
A particular character missing in all columns. Missing character changes or disappears on other printed lines.	Printhead out of timing. CANNOT be adjusted in the field. Consult factory.

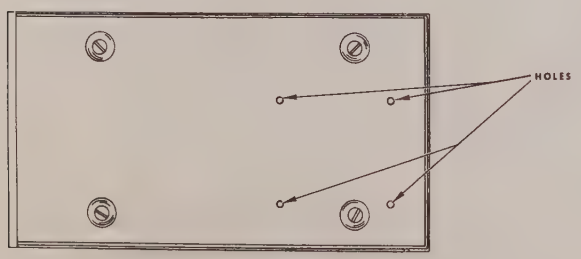
6.2 Front Panel Lamp Replacement

To replace a bulb, first remove the front plastic button by pulling straight out. Next, insert a narrow point screwdriver on the side of the bulb with the notch. Do not insert the screwdriver all the way. Slide the bulb away from notched side and pop it out. To add a new bulb, simply push straight in until it is held in place.

6.3 Printhead Removal and Installation (See figure 14)

To remove the printhead, first remove the cover and the paper, then tilt the printer and insert a screwdriver into the holes on the botton of the printer and remove the four screws. After the screws are removed, lift up on the printhead.

To reinstall, set the printhead back on the paper bin and start screws by inserting hand into the paper bin. To complete installation, tighten the screws using the holes on the bottom of the instrument.



Printer Bottom View
Figure 14

6.4 Power Conversion 110/220 Volts (See figures 4 and 15)

The change from 110 volt operation to 220 volt operation requires removing the jumpers from transformer T1, pin 1 to 3 and pins 2 to 4, and adding a jumper from pin 1 to pin 2.

To change from 220 to 110 volt operation, remove the jumper between pins 1 and 2 and add a jumper from pin 1 to pin 3 and another from pin 2 to pin 4.

7. REPLACEMENT PARTS

Replacement parts for the components shown on schematics and component location drawings are listed in alpha-numerical order by reference designator under their respective assemblies. Each list can be found adjacent to its respective component location diagram.

7.1 Parts Ordering

It is recommended that replacement parts be purchased directly from United Systems Corporation. The minimum charge is $10.00 on all orders. The order should be sent to:

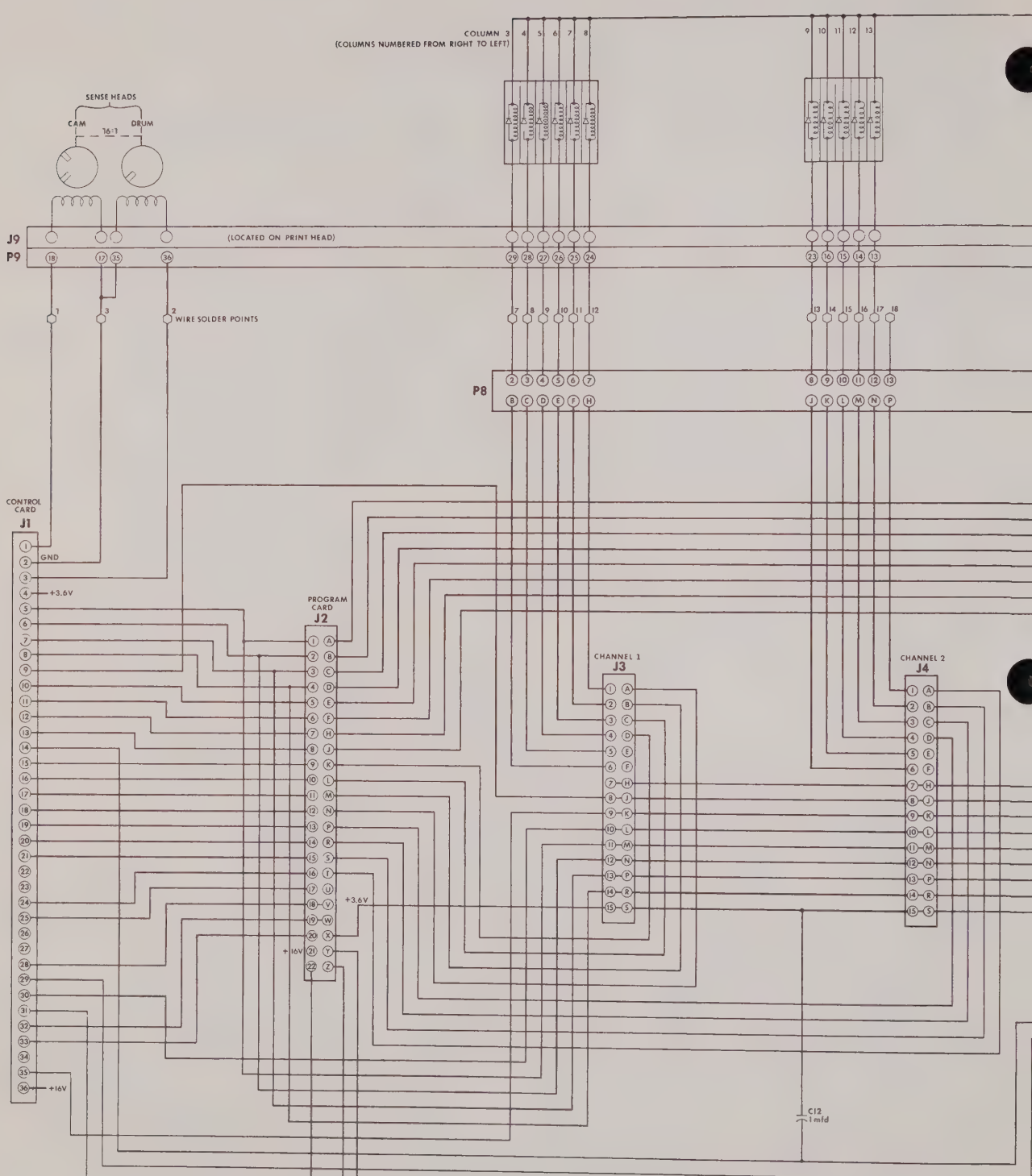
United Systems Corporation
918 Woodley Road
Dayton, Ohio 45403

For each replacement part, the following information should be included:

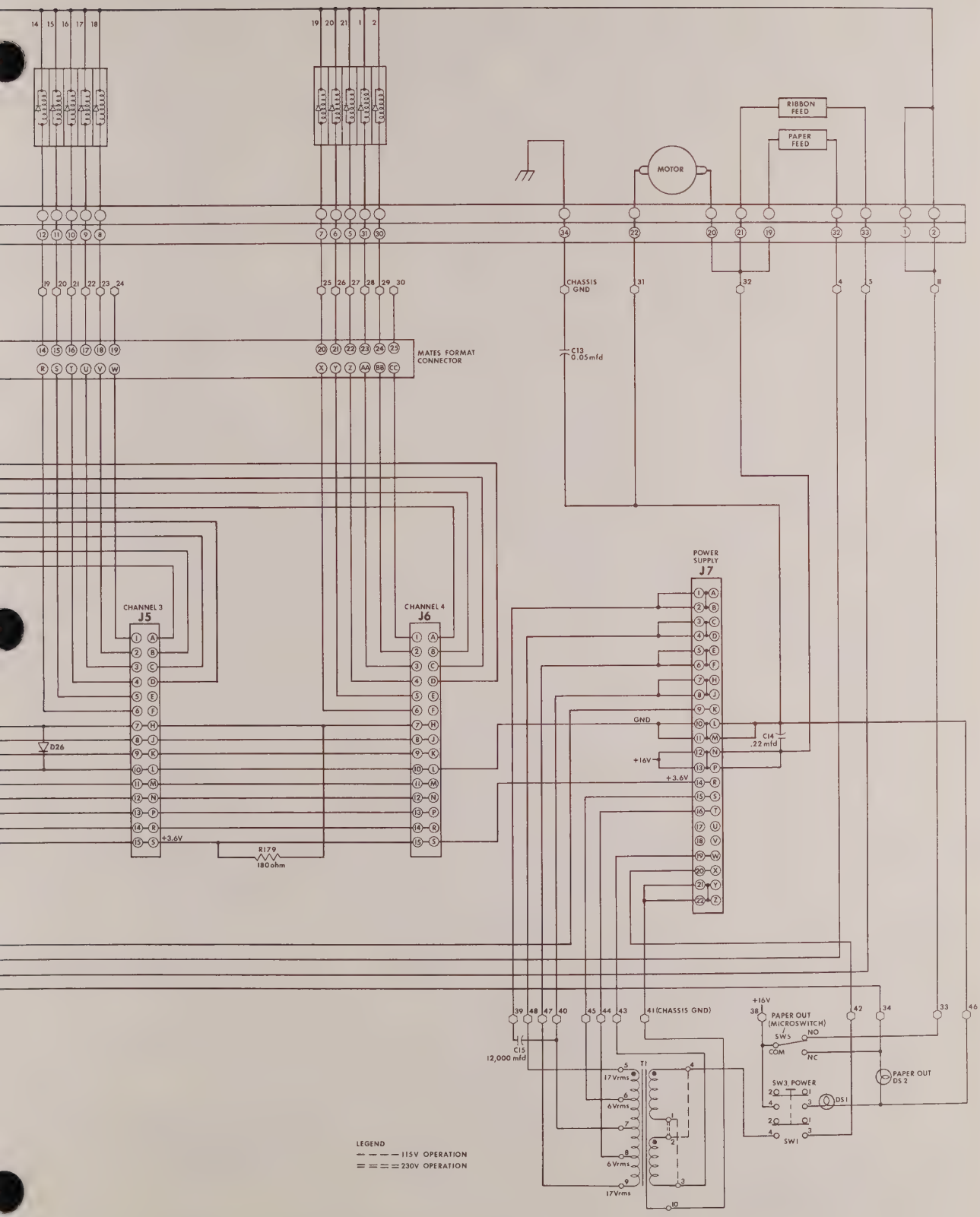
Instrument Model Number
Instrument Serial Number
Part Reference Designator
Part Description
Part Stock Number

Ref. Des.	Description	Stock Number
C1, 5, 14	Capacitor, mylar, 0.22μfd @ 200VDC	56-10206BYB224J2
C2	Capacitor, electrolytic, 1.8μfd @ 20VDC	56-10221A185K20
C3	Capacitor, ceramic, 200pfd @ 1KVDC	56-10215B201KT10
C4	Capacitor, mylar, 0.1μfd @ 200VDC	56-10205BYB104J2
C6, 7	Capacitor, mylar, 0.05μfd @ 200VDC	56-10205BYB503K2
C8	Capacitor, ceramic, 1500pfd @ 1KVDC	56-10215B152JT10
C10	Capacitor, electrolytic, 750μfd @ 50VDC	56-10202FT757N50
C11	Capacitor, electrolytic, 10,000μfd @ 10VDC	56-11364
C12	Capacitor, mylar, 1μfd @ 100VDC	56-10206CYC105J1
C13	Capacitor, mylar, 0.05μfd @ 600VDC	56-10205CYC503J6
C15	Capacitor, electrolytic, 12,000μfd @ 40VDC	56-10228-BC-123-T-40
D1, 2, 3, 4	Diode, signal, 1N4154	40-09297
D5, 6	Diode, zener, 24 volts	40-09247-01
D7, 8	Diode, power, 1N4720	40-11357
D9, 10, 12, 26, 27	Diode, power, 0.8 amp @ 100PIV	40-07787-01
D11	Diode, zener, 4.7 volts, 1N5230	40-09436
D13	Diode, zener, 16 volts, 10%	40-09219-09
DS1, SW1	Indicator/Actuator body	43-11409-02
	Lamp (DS1)	52-11412
	Lens, POWER	43-11802-06
	Switch (SW1)	43-11410-01
DS2	Indicator, body	43-11409-03
	Lamp (DS2)	52-11412
	Lens, PAPER OUT	43-11802-05
F1	Fuse, fast blow, 2 amp.	52-09310-07
	holder	50-07197
F2	Fuse: slow blow	
	1/2 amp. for 110VAC	52-09309-03
	1/4 amp. for 220VAC	52-09309-02
	holder	50-07197
IC1, 2, 7, 8, 9	Integrated circuit, dual J-K, flip-flop, Motorola MC 790 P	40-07485
IC3	Integrated circuit, J-K flip-flop, inverter 2 buffer, Motorola MC787P	40-07486
IC4	Integrated circuit, Quad 2 -input expanders, Motorola MC785P	40-09350
IC5, 6	Integrated circuit, Quad 2 -input NOR, Motorola MC724P	40-07483
IC10	Integrated circuit, triple three-input NOR, Motorola MC792P	40-09832
J1	Connector, printed circuit card, 36 contacts	51-09183
J2, 7	Connector, printed circuit card, dual rows, 44 contacts	51-07546-22
J3, 4, 5, 6	Connector, printed circuit card, dual rows, 30 contacts	51-07546-15
J8	Connector, format, printed circuit card, dual rows, 50 contacts	
	(not programmed)	51-07548-25
	(standard program)	51-11497-25
J9	Connector: Part of "Printhead"	
Q1, 3, 10, 12, 14, 18, 20, 21, 22, 24, 26, 28, 29, 30, 34, 37, 38, 41, 73	Transistor, 2N5172 supersedes 2N2926	40-11353
Q2, 4, 11, 13, 27, 72	Transistor, 2N4248	40-09437
Q5, 6, 7, 8, 9, 15, 16, 17, 31, 33, 35	Transistor, 2N4424	40-11439
Q19, 39	Transistor, power, 2N4918	40-11358

Ref. Des.	Description	Stock Number
Q23, 25	Transistor, unijunction, 2N2646	40-07794
Q32, 36, 40	Transistor, power, 2N5296	40-09145
Q42	Transistor, 2N441	40-11359
R1, 7, 8, 25, 34, 42, 43, 44, 56, 58, 70	Resistor, carbon, 1K, 10%, 1/4W	55-10101JK001
R2	Resistor, carbon, 82K, 10%, 1/4W	55-10101JK082
R3, 10, 29, 40, 45, 48, 49, 50, 63	Resistor, carbon, 10K, 10%, 1/4W	55-10101JK010
R4, 11, 26, 30, 31, 32, 33, 35, 55, 67, 181, 182	Resistor, carbon, 5.6K, 10%, 1/4W	55-10101JK005R6
R5	Resistor, carbon, 56K, 10%, 1/4W	55-10101JK056
R6, 13	Resistor, carbon, 220Ω, 10%, 1/4W	55-10101JA220
R9	Resistor, carbon, 39K, 10%, 1/4W	55-10101JK039
R12, 28, 37, 41, 61, 64	Resistor, carbon, 27K, 10%, 1/4W	55-10101JK027
R14, 16, 18,20,22, 36, 46, 53, 57, 59, 66, 76, 183, 184	Resistor, carbon, 470Ω, 10%, 1/4	
	Supersedes 680Ω for R36	55-10101JA470
R15, 17, 19, 21, 23, 47, 72, 74	Resistor, carbon, 100Ω, 10%, 1/4W	55-10101JA100
R24, 39, 62, 71, 73, 75, 77	Resistor, carbon, 680Ω, 10%, 1/4W	
	Supersedes 470Ω for R39	55-10101JA680
R27, 180	Resistor, carbon, 100K, 10%, 1/4W	55-10101JK100
R38, 60	Resistor, carbon, 18K, 10%, 1/4W	55-10101JK018
R51, 52, 65, 69	Resistor, carbon, 68Ω, 10%, 1/4W	55-10101JA068
R54, 68	Resistor, variable, 250K, 30%, 1/4W	55-10160TK250
R78	Resistor, wire wound, 220Ω, 10%, 2W	55-10124JA220
R79	Resistor, wire wound, 390Ω, 10%, 2W	55-10124JA390
R80	Resistor, carbon, 8.2Ω 10%, 1/2W	55-10102JA008R2
R81, 82	Resistor, carbon, 680Ω, 10%, 1/2W	55-10102JA680
R179	Resistor, carbon, 180Ω, 10%, 1/2W	55-10102JA180
R185	Resistor, wire wound, 0.56Ω, 10%, 2W	55-10124JA00R56
R186	Resistor, carbon, 470Ω 10%, 1/2W	55-10102JA470
R187	Resistor, carbon, 1.5K, 10%, 1/2W	55-10102JK001R5
SW1, 3, DS1	Actuator/Indicator body	43-11409-02
	Lamp (DS1)	52-11412
	Lens, POWER	43-11802-06
	Switch (SW1) (SW3)	43-11410-01
SW2, 4	Actuator/Indicator body	43-11409-01
	Lens, PAPER FEED	43-11802-03
	Lens, PRINT	43-11802-04
	Switch (SW2) (SW4)	43-11410-01
SW5	Switch, SPDT, Paper out	43-11414
T1	Transformer, power, dual primary, step down	42-11233
	AUX connector, printed circuit, dual row, 30 contacts, Cinch 251-15-36-160	51-07548-15
	Channel 1, 2, 3, 4, connector, printed circuit, dual row, 36 contacts, Cinch 251-18-36-160	51-07548-18
	Zero Ohm Jumper	50-07657
	Fuse holder for F1, F2	50-07197
	Printhead	47-09983
	Line cord and plug	53-09160
	Paper, 25 packs fan-fold	19-11512
	Paper, ribbonless, 25 packs, fan-fold	19-12053
	Ribbon, 12 rolls	19-11437-02
	Control Card, complete	05-11654
	Program Card	05-11372
	Input Card,	
	4 channel	691-1
	5 channel	691-2
	6 channel	691-3
	Power Supply Card, complete	05-11550

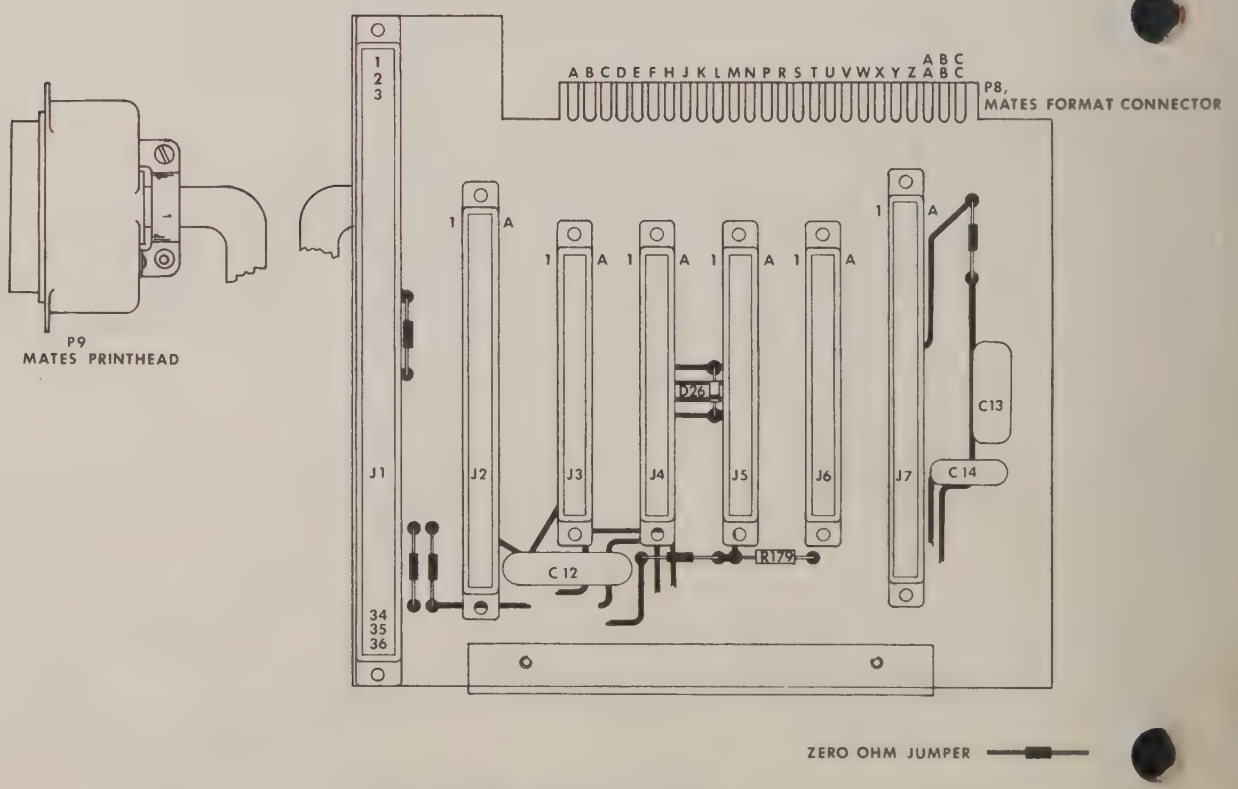


Mother Boa
Figu

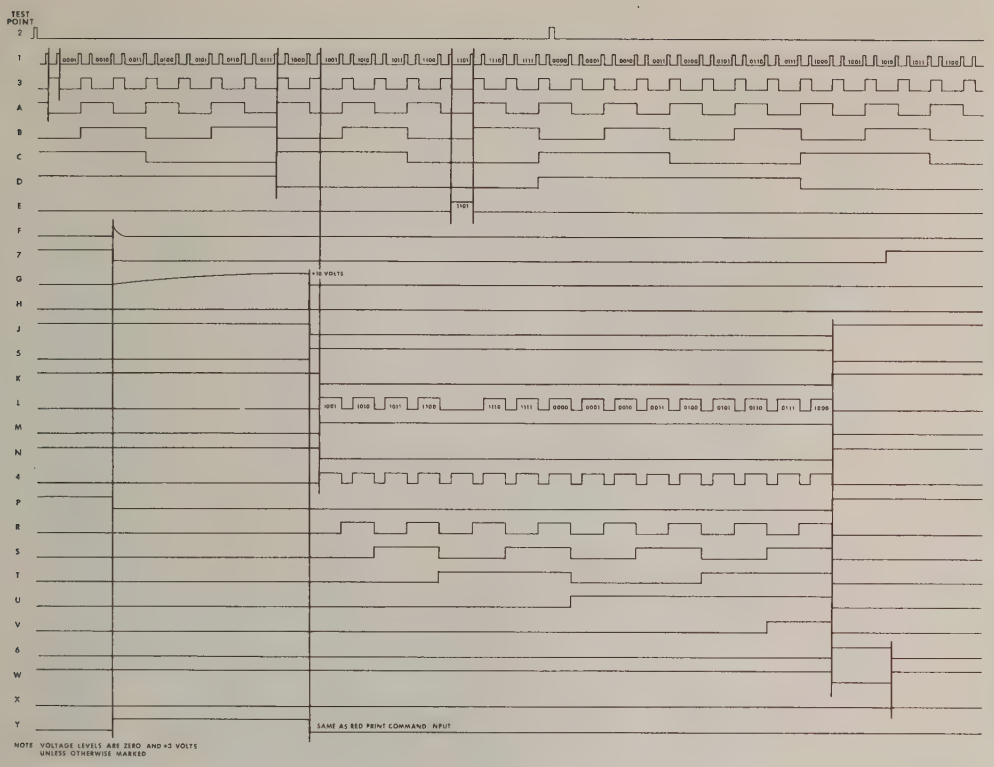

RIBBON FEED
PAPER FEED
MOTOR
CHASSIS GND
C13 0.05mfd
MATES FORMAT CONNECTOR
CHANNEL 3 J5
CHANNEL 4 J6
POWER SUPPLY J7
D26
+3.6V
R179 180ohm
GND
+16V
C14 .22 mfd
C15 12,000 mfd
T1
17 Vrms
6 Vrms
6 Vrms
17 Vrms
41 (CHASSIS GND)
PAPER OUT (MICROSWITCH)
SW5
NO
COM
NC
SW3 POWER
SW1
DS1
PAPER OUT DS 2
LEGEND
115V OPERATION
230V OPERATION

MOTHER BOARD

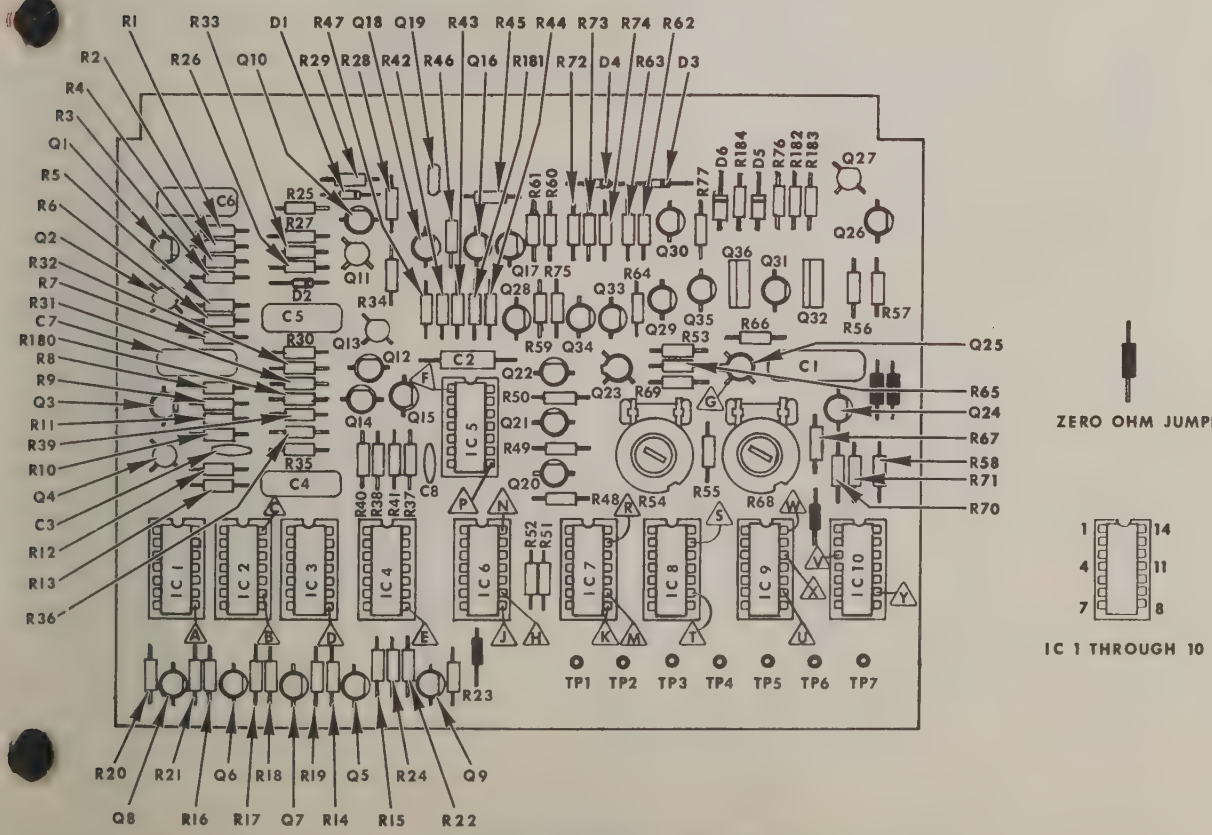
Ref. Des.	Description	Stock Number
C12	Capacitor, mylar, 1μfd @ 100VDC	56-10206CYC105J1
C13	Capacitor, mylar, 0.05μfd @ 600VDC	56-10205CYC503J6
C14	Capacitor, mylar, 0.22μfd @ 200VDC	56-10206BYB224J2
D26	Diode, power, 0.8 amp @ 100PIV	40-07787-01
J1	Connector, printed circuit card, 36 contacts	51-09183
J2, 7	Connector, printed circuit card, dual rows, 44 contacts	51-07546-22
J3, 4, 5, 6	Connector, printed circuit card, dual rows, 30 contacts	51-07546-15
J8	Connector, format, printed circuit card, dual rows, 50 contacts	
	(not programmed)	51-07548-25
	(standard program)	51-11497-25
P9	Connector, mates print head	51-11413
R179	Resistor, carbon, 180Ω, 10%, 1/2W	55-10102JA180



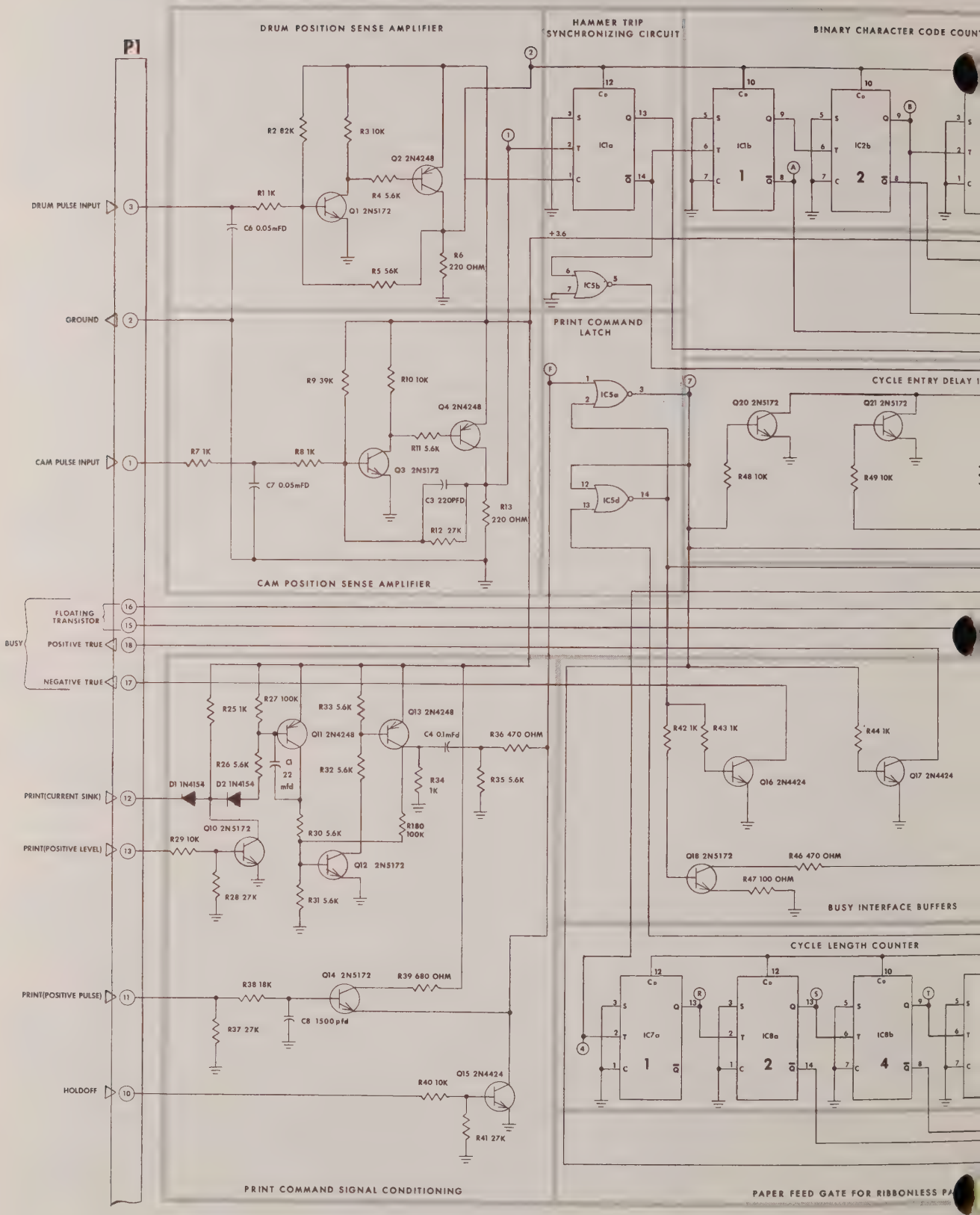
Mother Board Component Location
Figure 16



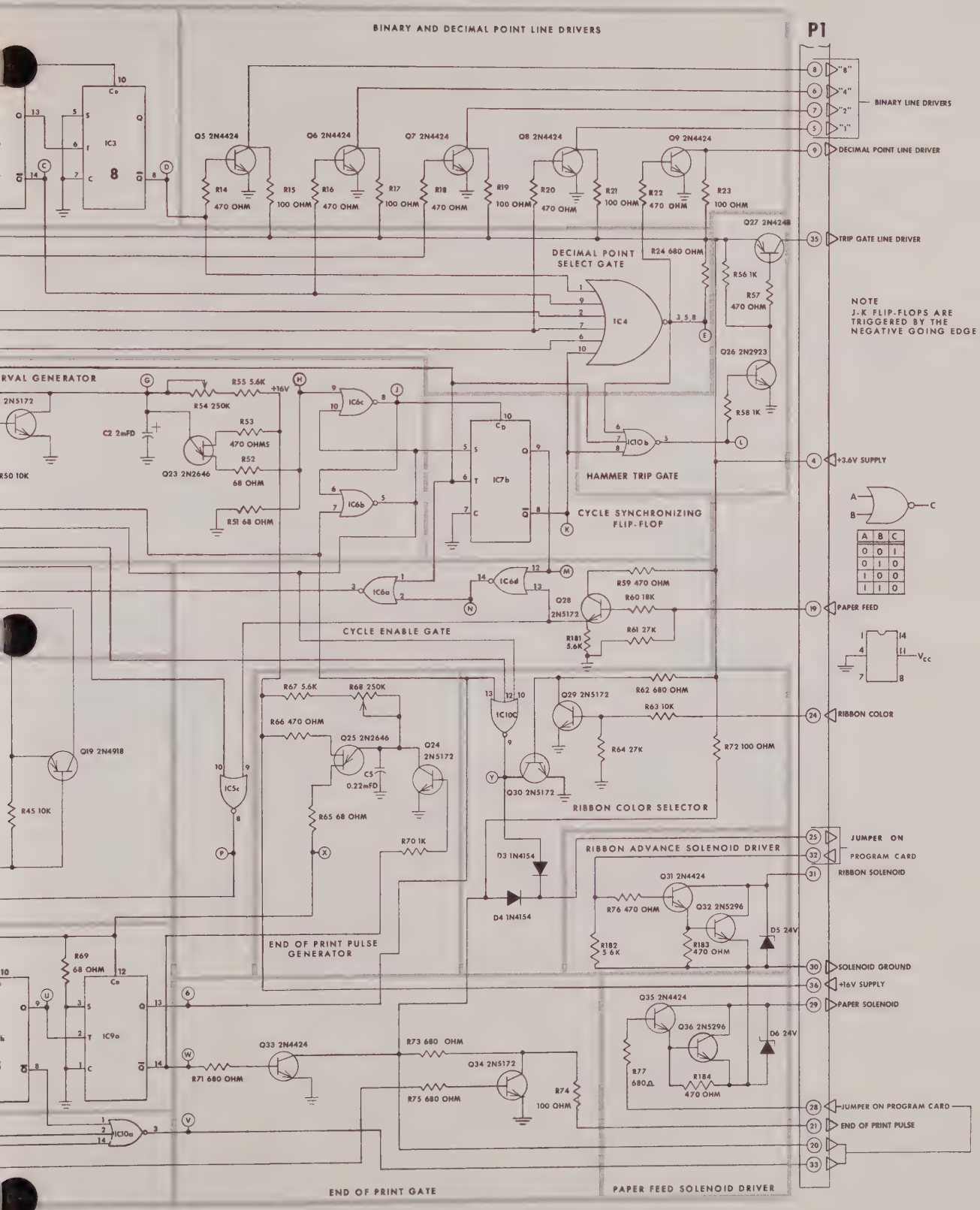
Control Card Waveforms
Figure 17



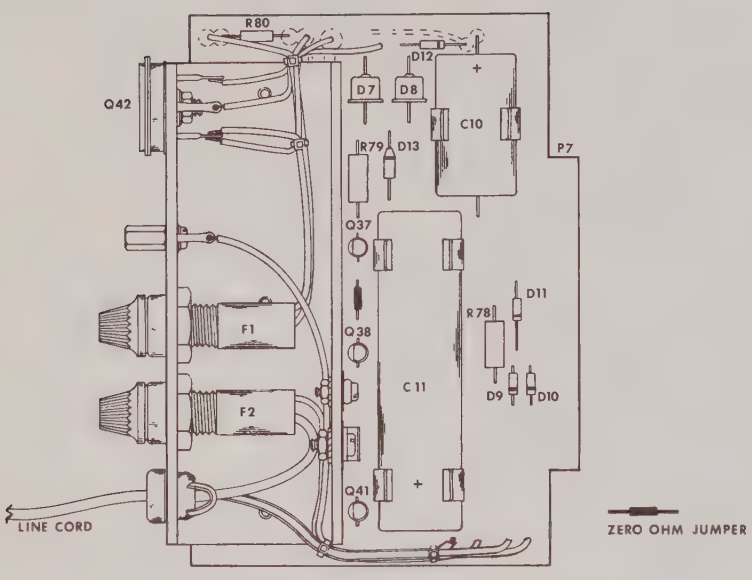
Control Card Component Location
Figure 18



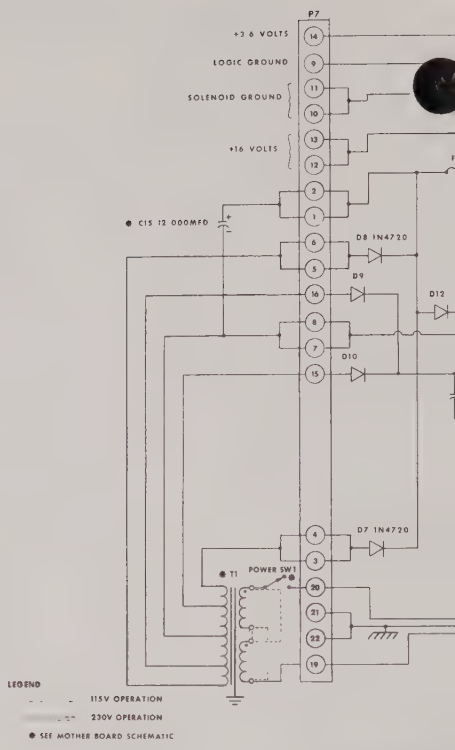
Control Car
Figu



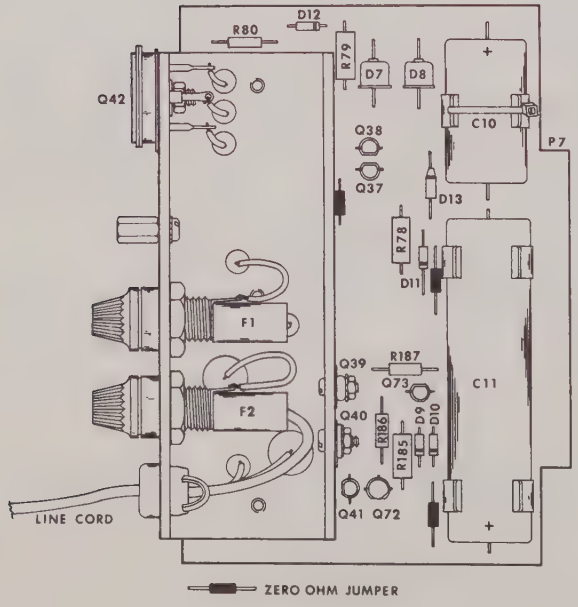
Schematic
19



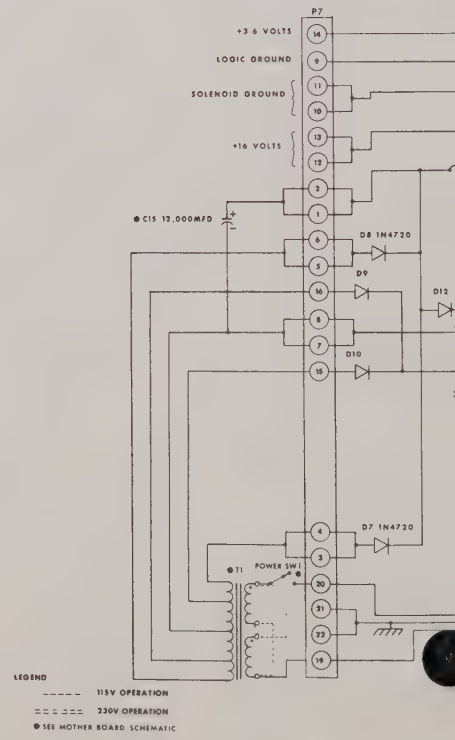
Type 1 Power Supply Card Component Location
Figure 20



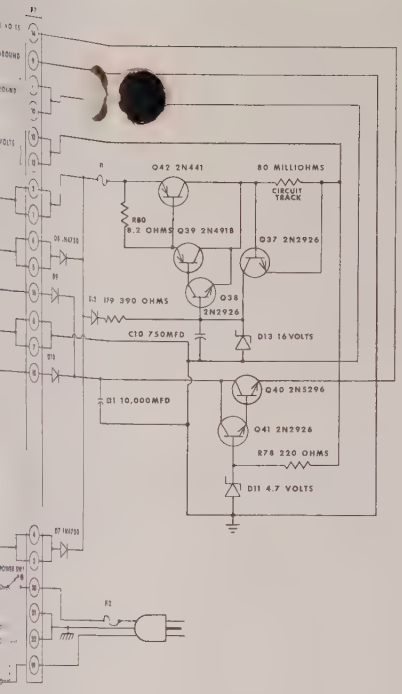
Type 1 Power Supply C
Figure 2



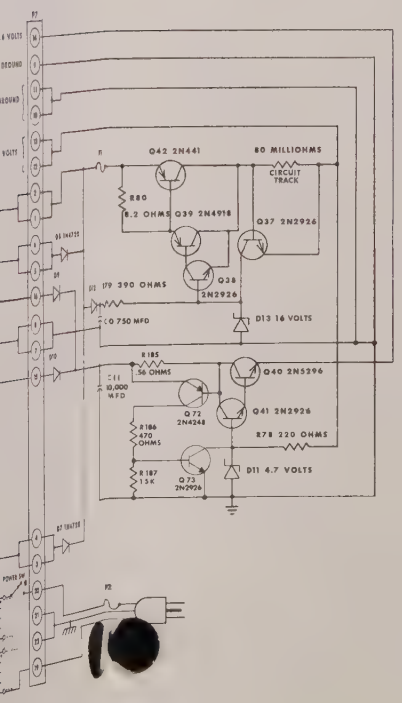
Type 2 Power Supply Card Component Location
Figure 22



Type 2 Power Supply Ca
Figure 23



ype 1 Power Supply Card **Schematic**
Figure 21



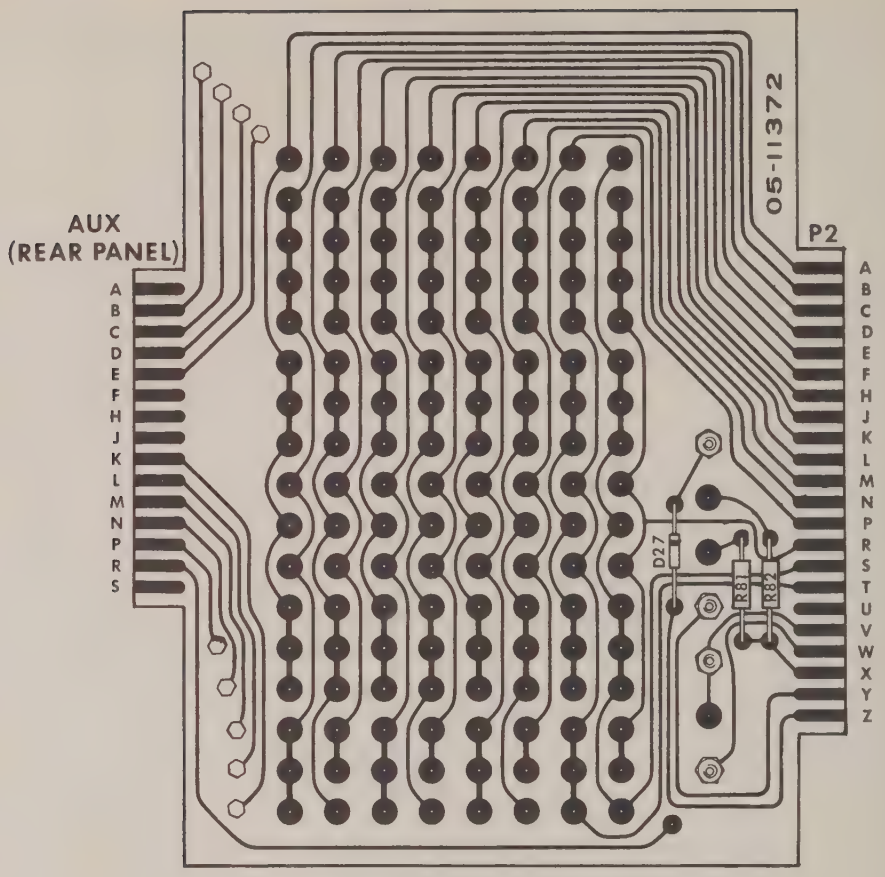
e 2 Power Supply Card **Schematic**

POWER SUPPLY CARD TYPE 1

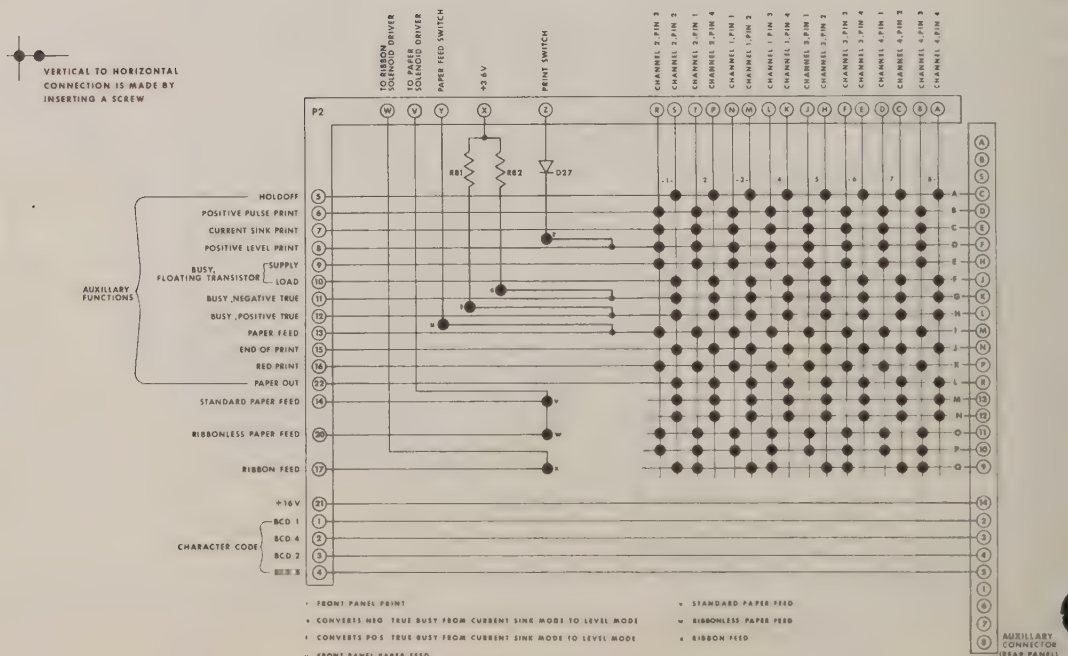
Ref. Des.	Description	Stock Numb
C10	Capacitor, electrolytic, 750μfd @ 50VDC	56-10202FT
C11	Capacitor, electrolytic, 10,000μfd @ 10VDC	56-10227EY
D7, 8	Diode, power, 1N4720	40-11357
D9, 10, 12	Diode, power, 0.8 amp @ 100PIV	40-07787-01
D11	Diode, zener, 4.7 volts, 1N5230	40-09436
D13	Diode, zener, 16 volts, 10%	40-09219-09
F1	Fuse, fast blow, 2 amp	52-09310-07
	holder	50-07197
F2	Fuse, slow blow	
	1/2 amp. for 110VAC	52-09309-03
	1/4 amp. for 220VAC	52-09309-02
	holder	50-07197
Q37, 38, 41	Transistor, 2N5172, supersedes 2N2926	40-11353
Q39	Transistor, power, 2N4918	40-11358
Q40	Transistor, power, 2N5296	40-09145
Q42	Transistor, power, 2N441	40-11359
R78	Resistor, wire wound, 220Ω, 10%, 2W	55-10124JA
R79	Resistor, wire wound, 390Ω, 10%, 2W	55-10124JA
R80	Resistor, carbon, 8.2Ω, 10%, 1/2W	55-10102JA

POWER SUPPLY CARD TYPE 2

Ref. Des.	Description	Stock Numb
C10	Capacitor, electrolytic, 750μfd @ 50VDC	56-10202FT
C11	Capacitor, electrolytic, 10,000μfd @ 10VDC	56-11364
D7, 8	Diode, power, 1N4720	40-11357
D9, 10, 12	Diode, power, 0.8 amp @ 100PIV	40-07787-01
D11	Diode, zener, 4.7 volts, 1N5230	40-09436
D13	Diode, zener, 16 volts, 10%	40-09219-09
F1	Fuse, fast blow, 2 amp	52-09310-07
	holder	50-07197
F2	Fuse, slow blow	
	1/2 amp for 110VAC	52-09309-03
	1/4 amp for 220VAC	52-09309-02
	holder	50-07197
Q37, 38, 41, 73	Transistor, 2N5172 supersedes 2N2926	40-11353
Q39	Transistor, power, 2N4918	40-11358
Q40	Transistor, power, 2N5296	40-09145
Q42	Transistor, 2N441	40-11359
Q72	Transistor, 2N4248	40-09437
R78	Resistor, wire wound, 220Ω, 10%, 2W	55-10124JA
R79	Resistor, wire wound, 390Ω, 10%, 2W	55-10124JA
R80	Resistor, carbon, 8.2Ω, 10%, 1/2W	55-10102JA
R185	Resistor, wire wound, 0.56Ω, 10%, 2W	55-10124JA
R186	Resistor, carbon, 470Ω, 10%, 1/2W	55-10102JA
R187	Resistor, carbon, 1.5K, 10%, 1/2W	55-10102JK



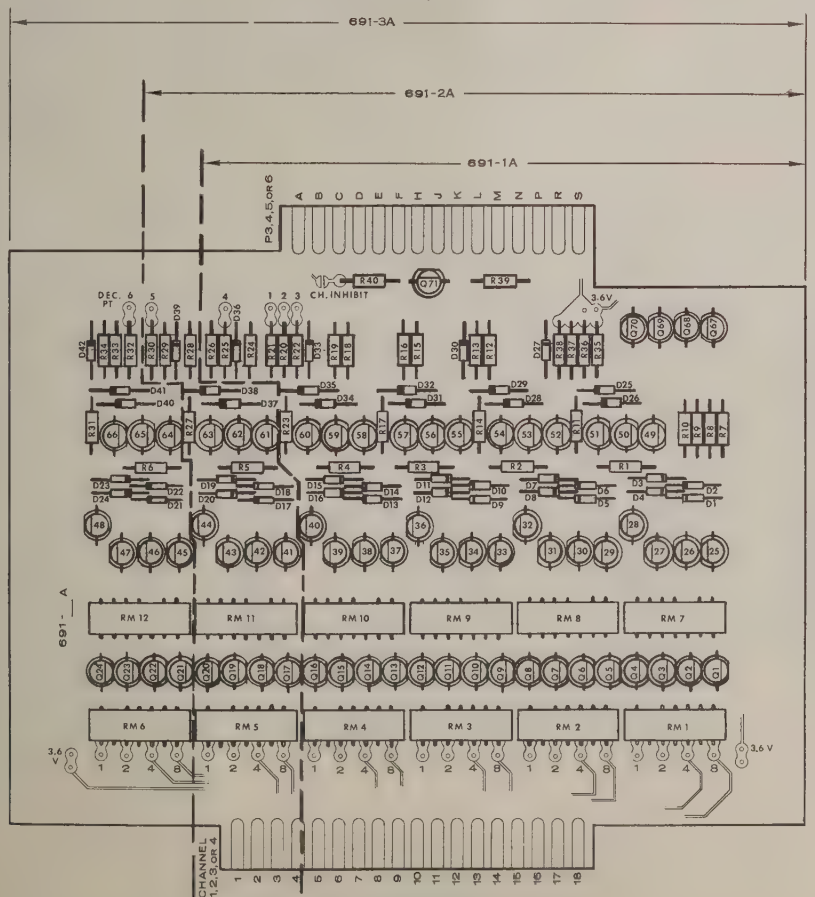
Program Card Component Location
Figure 24



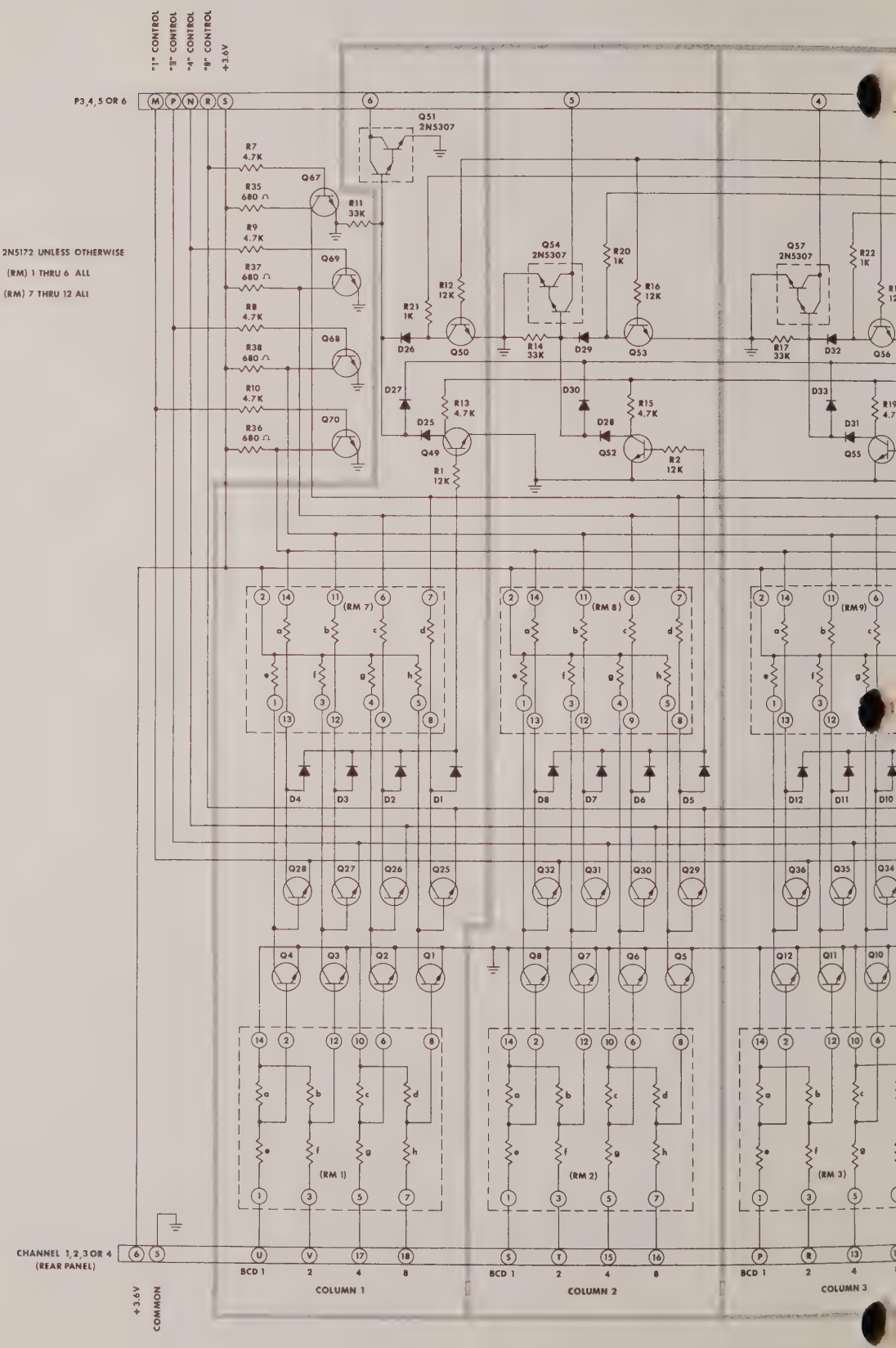
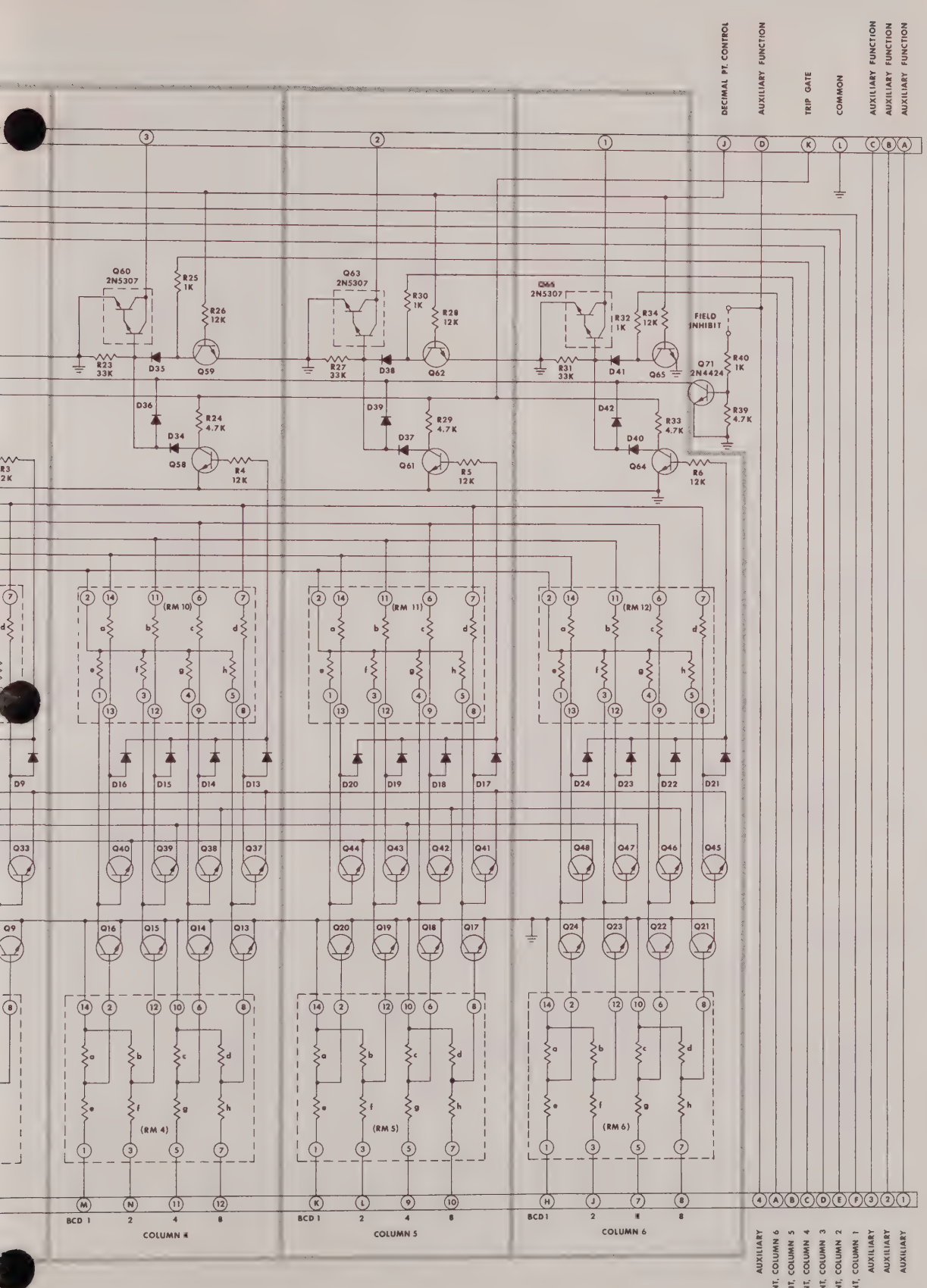
Program Card Schematic
Figure 25

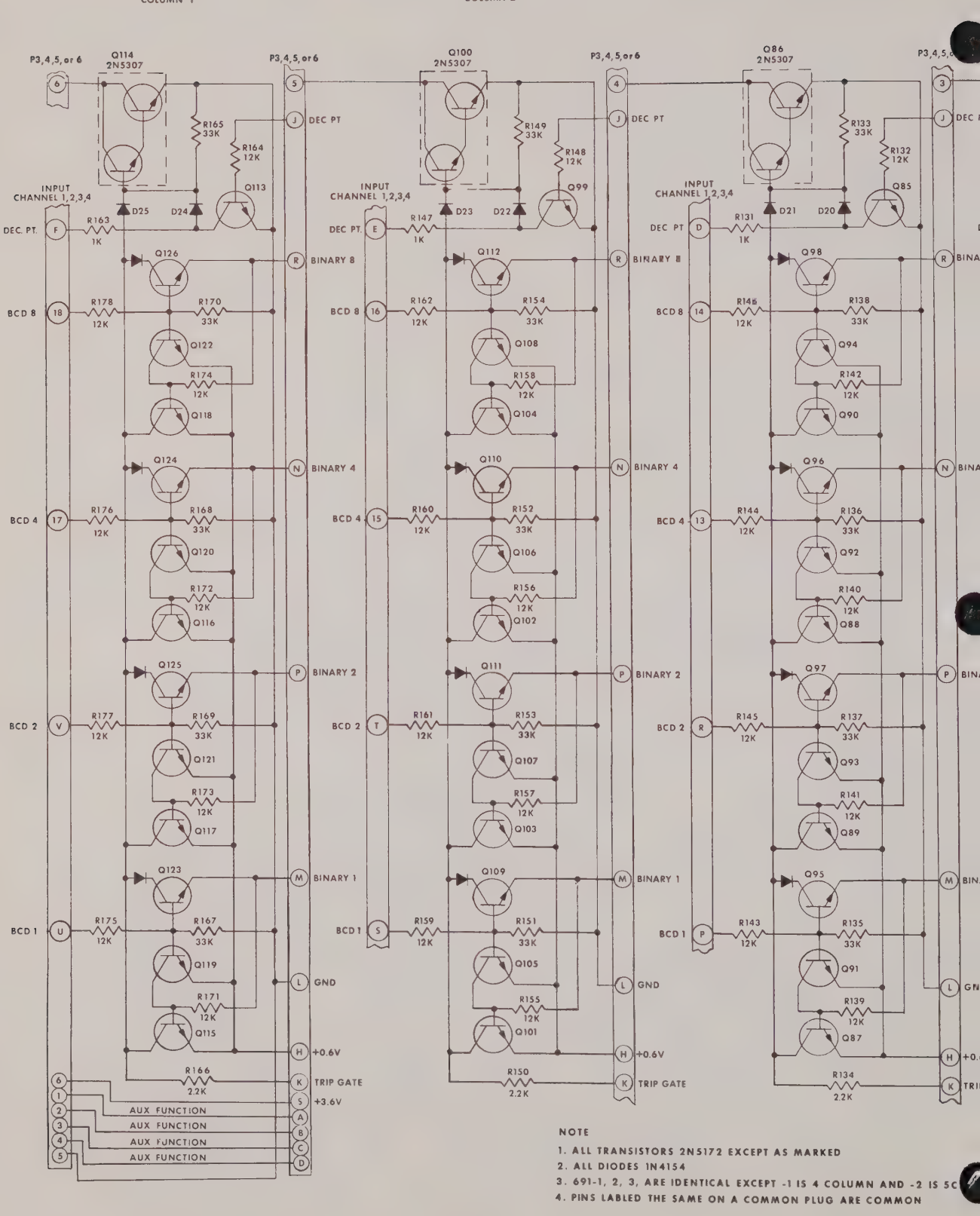
NOTE: Components listed are for a six column card. Four and five column cards do not contain all of the components listed.

Ref. Des.	Description	Stock Number
D1-42	Diode, signal, 1N4154	40-09297
Q1-50, 52, 53, 55, 56, 58, 59, 61, 62, 64, 65, 67-70, 73	Transistor, 2N5172	40-11353
Q51, 54, 57, 60, 63, 66	Transistor, Darlington, 22N5307	40-11408
Q71	Transistor, 2N4424	40-11439
R1-6, 12, 16, 18, 26, 28, 34	Resistor, carbon, 12K, 10%, 1/4W	55-10101JK012
R7-10, 13, 15, 19, 24, 29, 33, 39	Resistor, carbon, 4.7K, 10%, 1/4W	55-10101JK004R7
R11, 14, 17, 23, 27, 31	Resistor, carbon, 33K, 10%, 1/4W	55-10101JK033
R20-22, 25, 30, 32, 40	Resistor, carbon, 1K, 10%, 1/4W	55-10101JK001
R35-38	Resistor, carbon, 680Ω, 1/4W	55-10101JA680
RM1-6	Resistor Module, eight resistors, 20K, 10%, 0.1W	55-11864
RM7-12	Resistor Module, eight resistors, 4.5K, 10%, 20mW	55-11863
	Connector, input, printed circuit, dual row 36 contacts, Cinch 251-18-36-160	51-07548-18



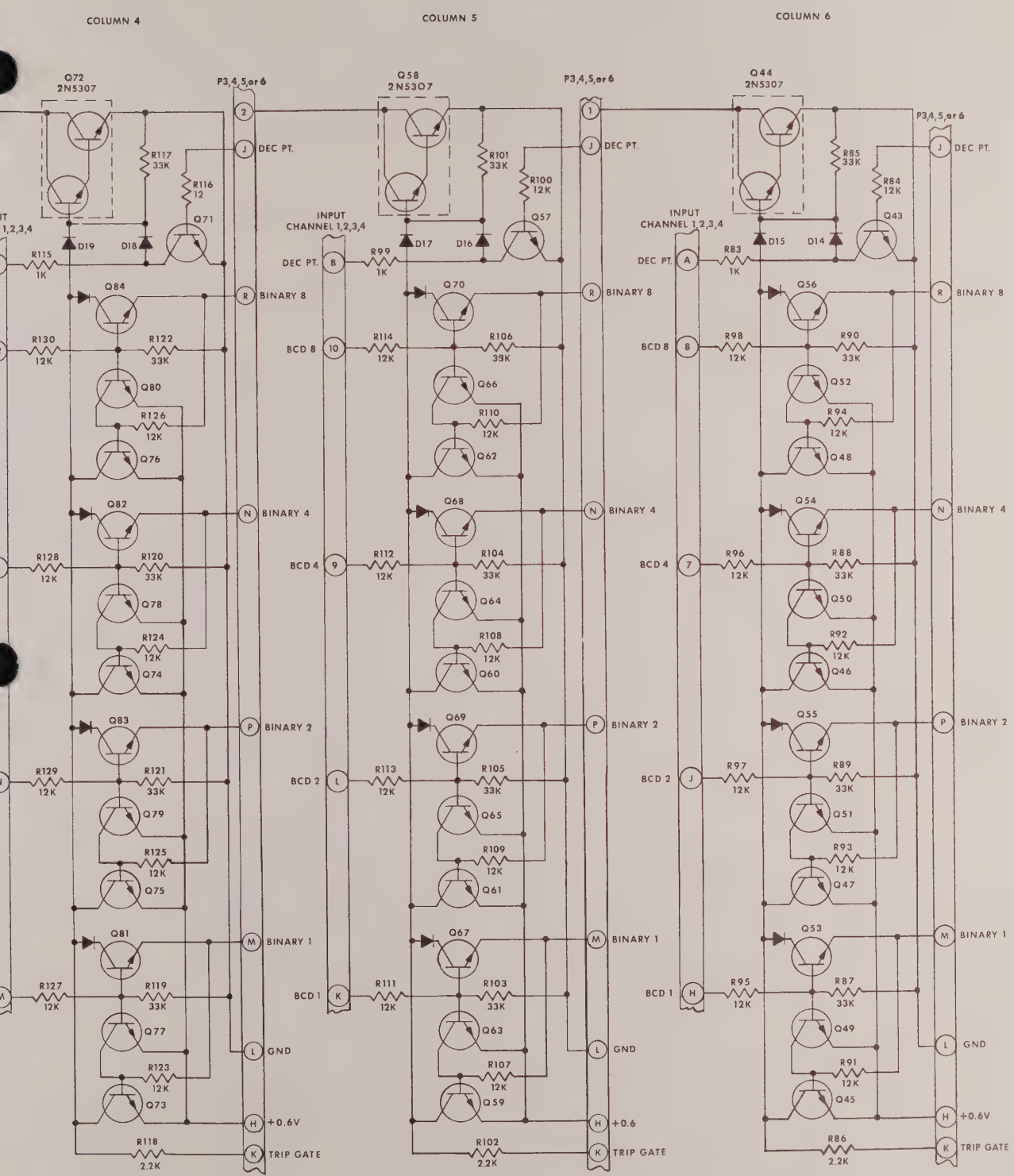
691-_A Input Card Component Location
Figure 26


"1" CONTROL
"2" CONTROL
"4" CONTROL
"8" CONTROL
+3.6V
P3,4,5 OR 6
NOTE!
ALL TRANSISTORS 2N5172 UNLESS OTHERWISE SPECIFIED.
RESISTOR MODULE (RM) 1 THRU 6 ALL RESISTORS 20K.
RESISTOR MODULE (RM) 7 THRU 12 ALL RESISTORS 4.5K.
Q51 2N5307
Q54 2N5307
Q57 2N5307
R7 4.7K
R35 680 Ω
R9 4.7K
R37 680 Ω
R8 4.7K
R38 680 Ω
R10 4.7K
R36 680 Ω
R11 33K
R12 12K
R20 1K
R16 12K
R22 1K
R21 1K
R14 33K
R17 33K
R13 4.7K
R15 4.7K
R2 12K
R1 12K
Q67
Q69
Q68
Q70
Q50
Q53
Q56
Q49
Q52
Q55
D26
D29
D32
D27
D30
D33
D25
D28
D31
(RM 7)
(RM 8)
(RM 9)
(RM 1)
(RM 2)
(RM 3)
D4 D3 D2 D1
D8 D7 D6 D5
D12 D11 D10
Q28 Q27 Q26 Q25
Q32 Q31 Q30 Q29
Q36 Q35 Q34
Q4 Q3 Q2 Q1
Q8 Q7 Q6 Q5
Q12 Q11 Q10
CHANNEL 1, 2, 3 OR 4 (REAR PANEL)
+3.6V
COMMON
BCD 1 2 4 8
COLUMN 1
COLUMN 2
COLUMN 3

ard Schematic
e 27



NOTE

1. ALL TRANSISTORS 2N5172 EXCEPT AS MARKED
2. ALL DIODES 1N4154
3. 691-1, 2, 3, ARE IDENTICAL EXCEPT -1 IS 4 COLUMN AND -2 IS 5C
4. PINS LABLED THE SAME ON A COMMON PLUG ARE COMMON

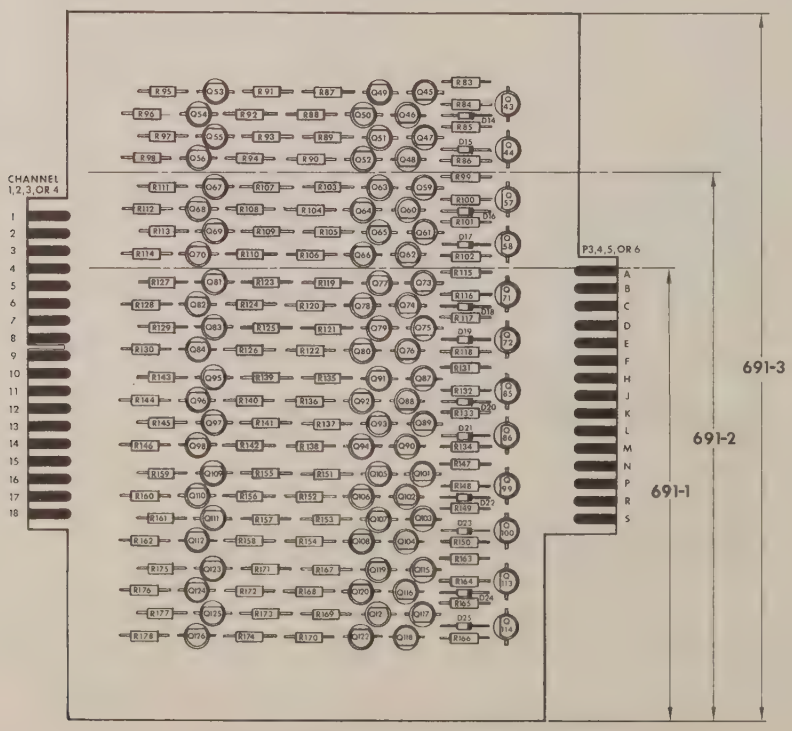


rd Schematic
8

NOTE: 1. Components listed are for a six column card. Four and five column cards do not contain all of the components listed.

2. Reference designators are a continuation of those used on the remainder of the printer.

Ref. Des.	Description	Stock Number
D14-25	Diode, signal, 1N4154	40-09297
Q43, 45-57, 59-71, 73-85, 87-99, 101-113, 115-126	Transistor and Diode combination	SK-561
	Transistor, 2N5172	40-11353
	Diode, 1N4154	40-09297
Q44, 58, 72, 86, 100, 114	Transistor, Darlington, 2N5307	40-11408
R83, 99, 115, 131, 147, 163	Resistor, carbon, 1K, 10%, 1/4W	55-10101JK001
R84, 91-98, 100, 107-114, 116, 123-130,132, 139-146, 148, 155-162, 164, 171-178	Resistor, carbon, 12K, 10%, 1/4W	55-10101JK012
R85, 87-90, 101, 103-106, 117, 119-122, 133, 135-138, 151-154, 167-170	Resistor, carbon, 33K, 10%, 1/4W	55-10101JK033
R86, 102, 118, 134, 150, 166	Resistor, carbon, 2.2K, 10%, 1/4W	55-10101JK002R2
	Connector, input, printed circuit, dual row 36 contacts, Cinch 251-18-36-160	51-07548-18



691-1, 2, 3 Input Card Component Location
Figure 29

Manufactured by

UNITED SYSTEMS CORPORATION
918 Woodley Road, P.O. Box 458, Dayton, Ohio 45401, U.S.A.
(513) 254-6251, TWX (810) 459-1728

BK121711K

Printed in U.S.A.

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